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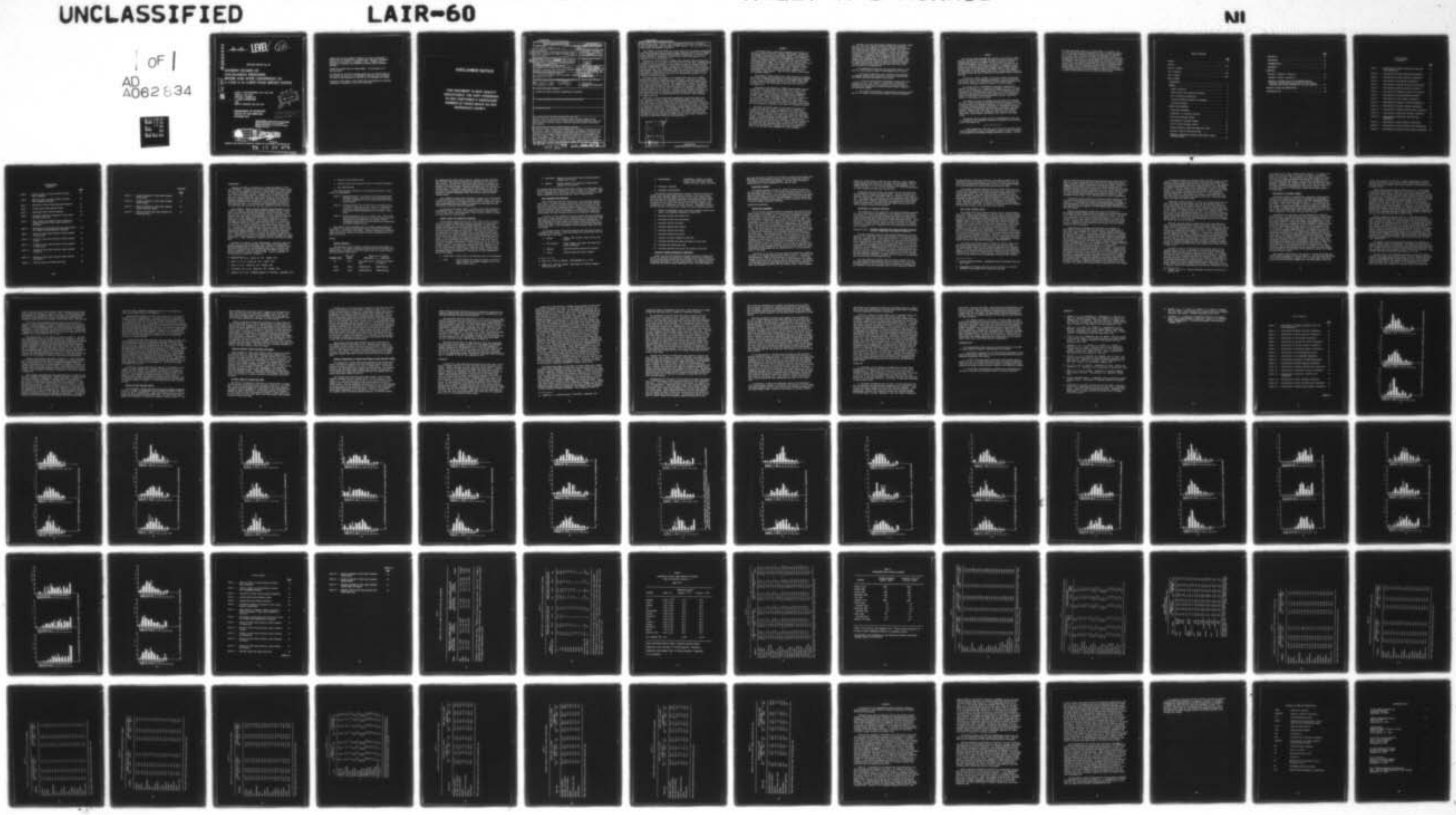

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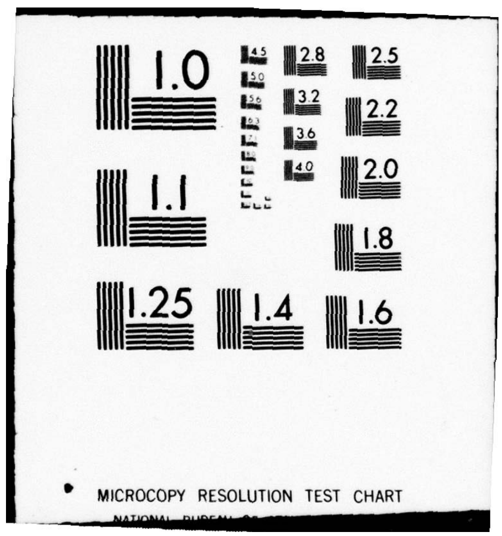
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NUTRIENT INTAKES OF NAS/ALAMEDA PERSONNEL BEFORE AND AFTER CONVERSION TO A CASH A LA CARTE FOOD SERVICE SYSTEM

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NOVEMBER 1978

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A nutrition survey, conducted by Letterman Army Institute of Research at Naval Air Station, Alameda (NAS/Alameda), California, was designed to evaluate the nutritional impact of conversion from the existing mixed ration-in-kind (RIK) commuted ration (COMRAT) standard dining hall system to an all-COMRAT Cash a la Carte system. Phase I was conducted in March 1975 to study the existing mixed RIK/COMRAT system. Phase 2 was conducted in June 1976 as an interim study following conversion to the Cash a la Carte system which was implemented on 1 March 1976. Phase 3 was conducted in August 1976 following a 5-month

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stabilization period. Phases 1 and 3 encompassed dining hall, biochemical/clinical examination, and total dietary intake aspects. Only the total dietary intake aspect was assessed in Phase 2.

This summary is based solely upon 17-day dining hall attendance and nutrient intake data obtained by the dietary interview technique from 35 RIK, 50 COMRAT-single (COM-S), and 48 COMRAT-married (COMM-M) participants in the March 1975 survey, and from 41 former RIK, 50 COM-S, and 63 COM-M participants in the June 1976 survey at NAS/Alameda, CA.

Conversion of RIK personnel to COMRAT status markedly reduced dining hall utilization from 31.6% in March 1975 to only 11.1% in June 1976. Implementation of item-pricing and renovation of the dining hall were not effective in stimulating a compensatory increase in dining hall utilization of COM-S (8.3% in 1975 vs. 11.0% in 1976). These conclusions can be projected to other military installations that, like NAS/Alameda, offer many readily available alternative food outlets. Conversely, these conclusions may not apply to those military bases where alternative food outlets are not conveniently accessible to the potential dining hall patron.

The major nutritional impact of the item-pricing policy was to reduce milk and milk product consumption and, consequently, calcium and riboflavin intakes per dining hall meal were reduced. Item-pricing also reduced citrus juice and citrus fruit consumption and, consequently, ascorbic acid intakes per dining hall meal were reduced. The average energy, protein, phosphorus, iron, and thiamin intakes per dining hall meal also decreased. Item-pricing and modifications to the menu were not effective in reducing the percent of calories derived from fat sources. Although nutrient intakes per dining hall meal decreased under the new system, the mean intakes (with the exception of energy) still met or exceeded one-third of the military daily allowance for these nutrients.

The Cash a la Carte system had an undesirable nutritional impact upon the total daily nutrient intakes of former RIK personnel. This was due to the combination of reduced dining hall utilization and reduced nutrient intakes per dining hall meal. The total daily milk and milk product consumption of the RIK group markedly decreased with a corresponding decrease in calcium and riboflavin consumption. Furthermore, the percentage of RIKs with calcium and riboflavin intakes below the recommended daily allowances increased after implementation of the Cash a la Carte system. The changes associated with item-pricing did not significantly affect the total daily nutrient intakes of single and married personnel on COMRAT because these groups consumed less than 12% of their daily calories in the dining hall.

ABSTRACT

A nutrition survey, conducted by Letterman Army Institute of Research at Naval Air Station, Alameda (NAS/Alameda), California, was designed to evaluate the nutritional impact of conversion from the existing mixed ration-in-kind (RIK) commuted ration (COMRAT) standard dining hall system to an all-COMRAT Cash a la Carte system. Phase I was conducted in March 1975 to study the existing mixed RIK/COMRAT system. Phase 2 was conducted in June 1976 as an interim study following conversion to the Cash a la Carte system which was implemented on 1 March 1976. Phase 3 was conducted in August 1976 following a 5-month stabilization period. Phases 1 and 3 encompassed dining hall, biochemical/clinical examination, and total dietary intake aspects. Only the total dietary intake aspect was assessed in Phase 2.

This summary is based solely upon 17-day dining hall attendance and nutrient intake data obtained by the dietary interview technique from 35 RIK, 50 COMRAT-single (COM-S), and 48 COMRAT-married (COM-M) participants in the March 1975 survey, and from 41 former RIK, 50 COM-S, and 63 COM-M participants in the June 1976 survey at NAS/Alameda, CA.

Conversion of RIK personnel to COMRAT status markedly reduced dining hall utilization from 31.6% in March 1975 to only 11.1% in June 1976. Implementation of item-pricing and renovation of the dining hall were not effective in stimulating a compensatory increase in dining hall utilization of COM-S (8.3% in 1975 vs. 11.0% in 1976). These conclusions can be projected to other military installations that, like NAS/Alameda, offer many readily available alternative food outlets. Conversely, these conclusions may not apply to those military bases where alternative food outlets are not conveniently accessible to the potential dining hall patron.

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Our recommendations based upon the nutritional impact of the Cash a la Carte system as tested at NAS/Alameda are as follows:

1. Discontinue conversion of all rations-in-kind personnel to commuted rations status, especially in military installations with readily available alternative food outlets.

2. If the a la Carte system is continued, provide milk, particularly low fat or 2% vitamin A fortified milk, item-priced sufficiently lower than cost (to be below soft drink prices), to stimulate milk consumption and thereby improve calcium, vitamin A, and riboflavin intakes.

3. Give further consideration to modifying the item-pricing system so as to improve the nutritional health of military personnel.

PREFACE

This interim report documents the results of the nutrient intake aspect of the March 1975 and June 1976 Nutrition Surveys conducted by Letterman Army Institute of Research (LAIR) at Naval Air Station, Alameda (NAS/Alameda), California. The purpose of this aspect of the survey was to evaluate the nutritional impact of conversion from the existing mixed ration-in-kind (RIK) commuted ration (COMRAT) standard feeding system to an experimental all-COMRAT Cash a la Carte system. The evaluation of the new feeding system was a collaborative effort of the United States Army Natick Research and Development Command (NARADCOM) and LAIR.

The work was jointly sponsored by the Army and Navy and was conducted under the DoD Food Research, Development, Testing and Engineering Program, Project No. 3A762760A822, Military Internal Medicine, Work Unit No. 086, Nutrition Studies in Support of DoD Food Program.

The authors wish to acknowledge the excellent cooperation by Captain E.D. McKeller, Jr., Commander, NAS/Alameda, and his able staff from the Supply Department, Captain Stubbs, CMDR Christensen, and CMDR Eckelberger; and the outstanding cooperation of the 287 enlisted personnel who participated in the dietary interviews, their personnel officers and department heads whose wholehearted support contributed greatly to the success of the survey.

The authors also wish to recognize the following LAIR personnel: Mr. John T. Hixon, Systems Applications Division, Department of Information Sciences, for invaluable assistance in data processing; Mr. Alan L. Hopkins, Biometrics Division, Department of Information Sciences, for assistance in statistical analysis; and in particular, the interviewers: Marjorie Clark, Fay Tong, Judy Filkins, Alison Williams, Diana Lee, Alycia Wong, Maria Boosalis, Nancy Chan, Lynn Lincoln, Philip Mark, Eileen Jensen, Dena Maddox, Laura Finkler, and Miriam Thomas.

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C. Frank Consolazio, 1913-1976, one of the world's foremost nutritional physiologists, began his scientific career in 1929 as a laboratory technician at the Harvard Fatigue Laboratory in Boston. In 1947,

he joined the Federal service as a physiologist. He served at the U.S. Army Medical Nutrition Laboratory (in 1958, the name was changed to U.S. Army Medical Research and Nutrition Laboratory) in Chicago and in Denver where he became the Chief, Bioenergetics Division. He continued in this capacity at the Letterman Army Institute of Research, San Francisco, where he was an active member of the staff at the time of his death. Mr. Consolazio authored more than 200 scientific publications and participated in approximately 100 human nutrition-related field studies. His contributions to science and, in particular, to military nutrition are a lasting memorial to a man who was not only an outstanding scientist, but also a beloved friend, and an inspiration to those who knew him and were privileged to work with him.

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INTRODUCTION

Adequate nutrition is necessary for optimum performance of military personnel. Personnel in the field are supplied with field rations that are usually augmented with only a limited number of canteen items. In contrast, personnel in garrison status have more freedom to select their food from several sources. Formerly, most enlisted personnel ate in the unit's dining hall, which offered one or two entrees per meal and a limited choice of other items. Attendance was quite high. Surveys conducted during the 1950s by the United States Army Medical Nutrition Laboratory (1-4) showed that troops consumed an average of 3500 kcalories (kcal) per man within unit dining halls and that only 700 additional kcal per man per day were obtained from other sources.

More recently, liberal policies allowing single personnel to live outside of billets, and increased freedom of movement during non-duty hours, have made the military service much like civilian life. Also, many sources of food have become available through a proliferation of vendors, fast food shops, and restaurants on or near military installations; all of these compete with the military dining hall for the patronage of service personnel. As a larger proportion of enlisted personnel are converted from a rations-in-kind (RIK) to a commuted ration (COMRAT) status and, therefore, are given cash in lieu of a meal or galley pass, a smaller proportion attend the military dining halls (5). Concern has been expressed about the young single enlisted person's capabilities to manage his/her finances effectively and to obtain adequate nourishment regularly. This concern is directed especially toward those individuals who do not eat in the dining hall regularly (i.e., infrequently). Surveys to evaluate the nutrient intake of individual service personnel must also include nutrients consumed from other sources (i.e., home, restaurant, vendors) as well as the military dining hall.

The Naval Air Station, Alameda (NAS/Alameda), California study was conducted by the United States Army Natick Research and Development Command (NARADCOM) and the Letterman Army Institute of Research (LAIR). The overall objectives of the NAS/Alameda Study were to evaluate the impact of conversion from the existing mixed RIK/COMRAT standard dining hall system to a Cash a la Carte system. Factors considered in the evaluation included the following:

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1. Parrott, E.M. et al. Report No. 100. USAMNL, 1952.

2. Kuhl, W.J. et al. Report No 104. USAMNL, 1952.

3. Ryer, R. et al. Report No. 128. USAMNL, 1954.

4. Consolazio, C.F. et al. Report No. 166. USAMNL, 1955.

5. Siebold, J.R. et al. Technical Report No. 76-35-FS4. NARADCOM, 1976.

a. Morale of the enlisted person.

b. Nutrient intake and nutritional status of enlisted personnel.

c. Cost effectiveness.

LAIR concentrated on objective b and conducted the study of this aspect in three phases:

Phase 1 - Conducted during 7 to 23 March 1975 to study the mixed RIK/COMRAT system. This 17-day study encompassed dining hall, biochemical/clinical examination, and dietary intake aspects.

Phase 2 - Conducted during 7 to 20 June 1976 as an interim study (14 days) to evaluate the early impact of conversion to a Cash a la Carte system which began on 1 March 1976. Only dietary intake measurements were obtained in this phase.

Phase 3 - Conducted during 30 July to 15 August 1976. This 17-day study evaluated the new Cash a la Carte system after stabilization for approximately five months. Phase 3 encompassed dining hall, biochemical/clinical examination, and dietary intake aspects.

This present report addresses only the dietary intake aspect and is limited to a preliminary evaluation of data obtained during Phase 1 (March 1975), and Phase 2 (June 1976). Complete evaluation of these and other data will be included in subsequent reports encompassing all aspects of the study.

METHODS

Subject Selection.

Men from each of three distinct customer groups were selected to participate in the dietary record and interview aspect of the March 1975 (before Cash a la Carte) and June 1976 (after Cash a la Carte) surveys. The three groups studied were:

Customer Group	Meal Card Color	Description of Status March 1975	June 1976
RIK	Red	RIK-issued Galley Pass	Converted to COMRAT on 1 Mar 76
COM-S	White	COMRAT-Single	COMRAT-Single
COM-M	Blue	COMRAT-Married	COMRAT-Married

RIK personnel were given cash in lieu of a galley pass and, therefore, were the group most directly affected by conversion to the Cash a la Carte system. The COM-S and COM-M groups were studied to evaluate the effects of item pricing and dining hall renovation on dining hall attendance and nutrient intake. These groups also served as controls for the RIK group. It should be noted that all participants in the June 1976 survey were stationed at NAS/Alameda prior to 1 March 1976, and, therefore, received subsistence under the previous mixed RIK/COMRAT feeding system.

Unit personnel officers were requested to select from their rosters a specified number of participants from each customer group. Each participant was informed of the purpose of the survey and assigned to one of eight interviewers who was trained in dietetics and nutrition and was experienced in dietary interview techniques.

In the March 1975 study, 35 RIK, 50 COM-S, and 48 COM-M personnel completed the study. In June 1976, complete data were obtained from 41 RIK, 50 COM-S, and 63 COM-M personnel. Only a limited number of personnel participated in both surveys.

<u>Dietary Record and Interview Techniques</u>.

Daily nutrient intake data for the 17-day (March 1975) or 14-day (June 1976) survey periods were obtained by meeting with each participant twice weekly for a 20-minute dietary interview. At the first meeting, each man was asked to recall all foods and beverages consumed during the preceding day. The information obtained was recorded on a pocket-sized food consumption diary card. This card was returned to the participant as a guide to assist him in recording his food intake for the next 3 to 4 days on identical diary cards (one card each day). Participants were urged to fill out their cards following each meal or snack. At the subsequent twice-weekly interviews, the cards were returned to the interviewer for review and clarification of any unusual food items consumed, estimations of portion size, time of day item was consumed, and source of item (i.e., home, NAS/Alameda dining hall, restaurant, vendor). The interviewer assigned each item consumed to one of six "time-consumed" periods (i.e., breakfast period, between breakfast and lunch, lunch period, between lunch and supper, supper period, and between supper and breakfast). The sources of items consumed are defined as follows:

1. Dining Hall - Refers only to the enlisted galley at NAS/Alameda.

2. Home - Foods prepared and consumed at home or items prepared at home and consumed elsewhere (e.g., bag lunch, picnic, etc.).

3. Restaurant - Commercial food outlets which provide seating to consume food on site.

4. Vendors - Vending machines and commercial outlets where seating is not provided.

By reviewing the individual's entire diary record, the interviewer categorized each item as a component of either a "meal" or a "snack." Therefore, a hamburger and a can of soda might constitute a meal in one case and be classified as an in-between-meal snack in another case.

<u>Data Processing and Reduction</u>.

Each interviewer coded and verified his or her assigned participants' data. To obtain nutrient intake data, each food item consumed was coded according to the LAIR Nutrient Factor File, which is a compilation of many food composition tables including USDA Handbook No. 8 (6), and Bowes and Church Food Values (7). Recipes were estimated for complex food items (such as casseroles), and nutrients for that item were computed by using nutrient values for the individual components.

To obtain the best estimate of nutrient intake from the NAS/Alameda dining hall, actual recipes of food items served in the dining hall were used during the March 1975 survey to compute nutrient composition. The food ingredients in these recipes were weighed during the March 1975 survey, and these weights were used to compute the nutrient composition of the food items. Such information was not available during the June 1976 survey.

Our Nutrient Factor File system assigned each food item to one of 19 different food groups. These food groups were consolidated into the following seven food types:

1. Entrees - (meats, fish, poultry, eggs, and egg products).

2. Milk Products - (milk, cheese, ice cream, and other milk-product desserts).

3. Desserts - (non-milk-product desserts and sugars).

4. Citrus - (citrus fruits and citrus juices).

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6. Watt, B.K., and A.L. Merrill. USDA Handbook No. 8, 1963.

7. Bowes, A.D., and C.F. Church. Food Values of Portions Commonly Used (11th ed.), 1970.

5. Miscellaneous - (vegetables, tomatoes, potatoes, soups, fruits other than citrus, legumes and nuts, butter, and fats).

6. Beverages, alcoholic

7. Beverages, non-alcoholic

Each subject's data values were initially reduced to reflect his average daily nutrient intake from all sources. From these values, average daily nutrient intakes for each of the three customer groups were computed, and histograms reflecting the percentage of each group consuming specific nutrients within given ranges were derived. The percentages of each group with average daily nutrient intakes below recommended daily allowances were also computed. Furthermore, individual and customer group data were computed for the following variables:

1. Number of NAS/Alameda dining hall meals consumed during survey period, and attendance patterns at dining hall.
2. Nutrients derived from dining hall.
3. Nutrients derived from restaurants.
4. Nutrients derived from home.
5. Nutrients derived from vendors.
6. Nutrients derived from meals.
7. Nutrients derived from snacks.
8. Quantity of foods consumed by food type.
9. Nutrients derived from meals and snacks by food type.
10. Nutrients per dining hall meal.
11. Nutrients derived from dining hall meals by food type.

Interview Technique Reliability Assessment.

During the March 1975 survey, an attempt was made to assess reliability by comparing the dining hall nutrient intake data obtained by the interview technique with the data obtained by an observer technique. Dietitians stationed at the end of each serving line observed and recorded the food items on each individual's tray. The total amount of

each food item served divided by the number of portions served minus each individual's plate waste was computed, and these values were coded as the quantity of each food item consumed. The same table of nutrient values was used in the processing of both sets of data.

Statistical Methods.

A two-factor analysis of variance (ANOVA) procedure was used to test for phase (March 1975 and June 1976) and group status (RIK, COM-S, and COM-M) mean differences. If a variable was significant at the 0.05 level by the F-test, it was tested for group differences with the Newman-Keuls multiple comparison test. The Mann-Whitney U and Chi Square procedures were also used, as appropriate, to test for effects of the Cash a la Carte system on selected variables.

RESULTS AND DISCUSSION

Dining Hall Attendance.

One of the most striking effects of conversion from the mixed RIK/COMRAT system to the Cash a la Carte system was the decrease in dining hall attendance by the RIK group. Dining hall utilization is defined as meals taken ÷ meals offered x 100. As shown in Table 1, the RIK group utilized the dining hall for 31.6% of their meals in March 1975, but reduced ($P < 0.001$) their utilization to 11.1% in June 1976, three months after conversion to the Cash a la Carte system. The attendance rate of the RIK group after conversion to COMRAT status was similar to that of the COM-S group during both surveys (8.3% in 1975 and 11.0% in 1976). The COM-M group ate only 1.0% of their meals in the dining hall in 1975, but modification of the feeding system did increase ($P = 0.001$) its dining hall utilization (5.3%) to about one-half the frequency of the COM-S group. The increased dining hall utilization by the COM-M group and slight but nonsignificant ($P = 0.284$) increase in the utilization by the COM-S group did not completely compensate for the large decrease in utilization by the RIK group as evidenced by a slight but nonsignificant ($P = 0.817$) decrease in utilization by the combined groups (11.8% in 1975 vs. 8.7% in 1976). The effect of the Cash a la Carte system on dining hall headcount cannot be directly assessed from these data because information on the size of the RIK, COM-S, and COM-M populations at NAS/Alameda was not made available to us during either phase of the study.

The effect of the Cash a la Carte system on dining hall attendance patterns of the sampled populations is shown in Table 2. Conversion of RIK personnel to COMRAT status resulted in a greater ($P < 0.001$) percentage (41.5% in 1976 vs. 8.6% in 1975) of that population not eating a single dining hall meal during the entire survey period. Furthermore, the utilization rate of those RIKs that ate at least one dining hall meal also decreased (34.6% in 1975 vs. 19.0% in 1976). The attendance

pattern of the RIK group in 1976 was quite similar to COM-S personnel whose pattern was not altered by the Cash a la Carte system. The new system decreased ($P < 0.01$) the percentage of non-attendance of the COM-M group from 83.3% to 57.1% and increased ($P < 0.05$) the percentage of those attending at least once per work day.

During the June 1976 survey, the dining hall was the focal point for enforcement of dress and grooming codes. Security personnel stationed at the door would not permit those in violation of the codes to enter the dining hall. Such was not the case during the March 1975 survey. This factor may have discouraged some individuals from attending the dining hall. However, the decline in attendance by the RIK group cannot be attributed to grooming code enforcement because COM-S and COM-M attendance rates did not decrease.

<u>Reliability of Interview Technique.</u>

The reliability of data obtained by the dietary interview technique is a factor which must be considered in the evaluation of the results of this study. Diary-interview technique and observer technique data bases were prepared and contained 423 man-days where the number of reported (during interviews) and observed dining hall meals agreed. These man-days of data were derived from 62 of the 133 subjects in the test population. Average nutrient intake per dining hall meal was computed from each data base and a comparison ratio was calculated for each subject as follows:

$$\text{COMPARISON RATIO} = \frac{\text{Nutrient intake/meal from Diary-Interview Technique}}{\text{Nutrient intake/meal from Observer Technique}}$$

The mean comparison ratio for each nutrient examined and the percentage of the individuals within the population with comparison ratios less than or greater than 1.0 are shown in Table 3. The mean comparison ratio for energy was 0.92, which suggests that the diary-interview technique underestimated the energy intake of the population by an average of 8%. However, the energy intake at dining hall meals of 72.6% of the individuals in the population was underestimated by the diary-interview technique. The low comparison ratio of 0.78 for ascorbic acid is partially artifactual. If an individual selected an orange (high in ascorbic acid), but did not eat it until after leaving the dining hall, the observer technique considered it to be consumed with the meal, whereas the diary-interview technique considered it to be part of a between-meal snack and not part of the dining hall meal.

Food item selection analysis (data not shown) revealed that the food items selected agreed between the two techniques 80% of the time. Fourteen percent of the total food items in question were observed but not reported to have been consumed, and 6% of the items were reported

but not observed to have been selected. This greater tendency for an individual to have been observed to consume a food item but not to report it on his diary card contributed, in part, to the overall average of 8% underestimation of energy intake per dining hall meal.

The preceding analyses indicate that the nutrient intake data obtained with diary-interview technique are biased (low) estimates of dining hall and, presumably, total daily nutrient consumptions of the studied populations. The same diary-interview technique was used in both studies and, therefore, it appears reasonable to assume that the direction and magnitude of bias were also similar in both studies. Bias in the data does not alter the level of significance of statistical tests. Therefore, comparison of nutrient consumptions of population groups before and after Cash a la Carte is a valid procedure to evaluate the nutritional impact of the new food service system.

Daily Total Nutrient Intake.

The average total daily nutrient intakes from all sources (dining hall, home, vendor, and restaurant) of the RIK, COM-S, and COM-M groups before and 3 months after conversion to the new feeding system are shown in Table 4. The Recommended Dietary Allowances (RDA) of the National Research Council (NRC) (8) and the Military Daily Dietary Nutrient Allowances (MDA) (9) are shown in Table 5 and were used as standards to evaluate the nutrient intakes of the sampled populations. These recommendations are estimates of the amounts of nutrients which should be consumed on a daily basis to meet the physiological needs of most healthy personnel under normal conditions. The nutritional needs of most, but not necessarily all, individuals in a population are satisfied when the population's average intake of nutrients (except energy) meets or exceeds the recommended allowances. Conversely, the incidence of abnormal biochemical indices and clinical signs of nutritional deficiency is predicted to increase in relation to how far a population's average intake is below the recommended allowances. (See Appendix C)

The average total daily nutrient intakes for the RIK, COM-S, and COM-M groups before and after Cash a la Carte are shown in Table 4. The average energy intake for the combined populations (287 subjects) was 2552 kcal/day, which was 80% of the MDA (3200 kcal) for moderately active, 19- to 25-year-old male military personnel, and 85% of the RDA (3000 kcal) for men 19 to 25 years of age. The discrepancy between the reported energy intakes and the recommended allowances also suggests

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8. National Research Council. Recommended Dietary Allowances (8th rev. ed.), 1974.

9. Departments of the Army, the Navy, and the Air Force. AR 40-25/ BUMEDINST 10110.3E/AFR 160-95, 1976 (as corrected).

that the diary-interview technique underestimated total daily energy intake by at least, and possibly more than, the 8% underestimation previously noted for energy consumption at dining hall meals. Further assessment of the validity of the total daily energy intake data is precluded because body weight changes and caloric expenditures were not measured and other necessary supporting data such as body weight, height, and body composition were gathered only during the March 1975 survey. The reader should also be aware that the reported intakes of other nutrients are also likely to be underestimates of actual consumptions.

The average protein intakes of all groups greatly exceeded the RDA of 54 gm/day and were near or slightly above the MDA of 100 gm/day (Table 4). In the March 1975 survey, the average percent of energy intake attributable to fat was at or below the desirable proportion of less than 40% from fat sources, but was slightly above the level in the June 1976 survey.

Calcium and phosphorus intakes were above the allowance of 800 mg/day for these minerals, with the exception of the calcium intakes of the COM-M group in June 1976, which averaged 763 mg/day. The calcium: phosphorus (Ca:P) ratios were adequate (range 1:1.5 to 1:1.9), but were near the upper limit of ranges recommended by the NRC (1:0.5 to 1:2). Average iron intakes (range 13.8 to 16.3 mg/day) were below the MDA (18 mg/day) for all groups in both studies, but did, however, exceed the RDA of 10 mg/day.

Average vitamin A intakes were lower than the allowance of 5000 IU/day for all groups with the exception of the COM-M group in March 1975, which averaged 5414 IU/day. Average thiamin intakes for all groups (range 1.15 to 1.34 mg/day) were below the MDA (1.6 mg/day) and the RDA (1.5 mg/day). However, when thiamin intakes are expressed per 1000 kcal consumed, as proposed by the NRC, thiamin intakes ranged from a low of 0.47 mg/1000 kcal for the 1975 RIK group to a high of 0.53 mg/1000 kcal for the 1975 COM-M group. These values are close to the NRC recommendations of 0.5 mg thiamin/1000 kcal. Average riboflavin intakes for all groups were above the RDA of 1.8 mg/day and 0.6 mg/1000 kcal. The riboflavin intakes (1.94 mg/day) of the RIK and COM-M groups in 1976 were below the MDA of 2.0 mg/day. Average niacin intakes were above the RDA of 20 mg/day, but the niacin intakes of the COM-S group in both 1975 (20.6 mg/day) and 1976 (20.3 mg/day), and the RIK group in 1976 (20.1 mg/day) were lower than the MDA of 21 mg/day. The NRC has recommended a niacin intake of 6.6 mg/1000 kcal consumed. This level of niacin intake was exceeded by all groups (range 7.29 to 9.28 mg/1000 kcal). Average ascorbic acid intakes were greater than the RDA of 45 mg/day. However, the ascorbic acid intakes of the 1976 RIK group (58.7 mg/day) was below the MDA for ascorbic acid of 60 mg/day.

A two-factor analysis of variance (ANOVA) was used to test for significant effects of phase (March 1975 vs. June 1976) and status (RIK, COM-S, and COM-M groups) upon total daily nutrient intake. The resultant F-values and associated P-values are shown in Table 6. The mean nutrient intake values for Phases 1 and 2, independent of status, are shown in Table 7. It should be noted that carbohydrate, fiber, calcium, phosphorus, iron, sodium, potassium, thiamin (mg/day), and riboflavin (mg/day) intakes were significantly (F-test, $P < 0.05$) decreased in June 1976 (Table 6). The percent fat calories, niacin/1000 kcal, and Ca:P ratio were significantly increased in June 1976, following conversion to the Cash a la Carte System.

Significant effects (F-test, $P < 0.05$) of the status factor on calcium, Ca:P ratio, and niacin/1000 kcal were also observed (Table 6). The calcium intake of the combined (mean of 1975 and 1976 groups) COM-M group (790.8 mg/day) was less ($P < 0.05$, Newman-Kuels Test) than that of the combined RIK (983.5 mg/day) and COM-S (956.2 mg/day) groups which did not differ. In addition, the Ca:P ratio of the combined COM-M group (1:1.85) was significantly greater ($P < 0.05$) than the corresponding intakes of the combined RIK (1:1.64) and COM-S (1:1.60) groups. The niacin intake/1000 kcal of the combined COM-M group (9.14) was significantly greater ($P < 0.05$) than the corresponding intakes of the combined RIK (8.06) and COM-S (8.20) groups.

Multiple comparison analyses (Newman-Kuels Test) were applied to test for significant differences between group means (Table 4) if the ANOVA indicated significant ($P < 0.05$) phase x status interaction effects (Table 6). A significant interaction (F-test, $P < 0.05$) indicates that the relative ranking of group means (e.g., RIK > COM-S > COM-M) significantly changed from Phase 1 to Phase 2. A significant interaction effect was observed for energy, carbohydrate, sodium, and riboflavin (Table 6). In 1976, RIKs were actually former RIK-status personnel receiving COMRATs (cash) in lieu of a galley pass. The RIK group significantly ($P < 0.05$, Newman-Kuels test) decreased its energy, carbohydrate, and riboflavin (mg/day) consumption in 1976 following conversion to COMRAT status. No significant phase effects were observed for either the COM-S or COM-M group.

Included in Table 7, along with the mean nutrient intake of the combined groups for Phase 1 and Phase 2, are the computed median and Hampel's robust location estimate (10) for each variable. The median describes the level of intake at which 50% of the population is consuming less and 50% is consuming more than the indicated value. Hampel's statistic estimates a typical value of a population by compensating for any extreme observations in the distribution. If these total daily nutrient intake data fitted a normal Gaussian distribution curve, the means, medians, and robust estimates would agree. Examination of Table 7, however, reveals that these data are not normally distributed but tend

10. Andrews, D.F. et al. Robust Estimates of Location: Survey and Advances, 1972.

to be skewed to the right (towards higher intakes). For example, the median and robust estimate for vitamin A intakes are considerably below the mean value. This indicates that a small proportion of the population is consuming extremely high amounts of vitamin A per day and is elevating the mean value to a point where the mean does not adequately represent the vitamin A intake of the population as a whole. Therefore, judgments and conclusions based solely upon the mean value of skewed data can be misleading and will tend to present a more favorable evaluation of the nutrient intakes than actually exists in the population.

Distribution of Nutrient Intakes.

One approach useful in assessing the nutritional characteristics (adequacy) of a population's diet is to determine the percentage of the population having nutrient intakes less than recommended dietary allowances. These values are shown in Table 8. In a series of figures (Figs. 1-17), the percentages of each of the groups studied that have nutrient intakes within certain specified ranges are presented. One nutrient is represented per figure and a histogram for each category of meal card status (RIK, COM-S, and COM-M) is presented to permit direct comparison of the March 1975 and June 1976 data.

Interpretation of this type of data presentation is limited by several factors. The MDA and RDA for males (19-22 years of age, weighing 67 kg) were applied to each subject in the population without regard to the individual's age, body weight, body composition, or level of physical activity. During the clinical examination aspect of the March 1975 survey, the average age at last birthday of the entire population was approximately 26 years, with 3 of the 133 subjects below 19 years of age. The average body weight was approximately 76.5 kg (R. A. Nelson, personal communication). All subjects who completed the study are represented in the distributions without regard to any subjective evaluation as to the validity and reliability of each subject's data. As previously mentioned, the dietary-interview technique underestimated the average nutrient intakes of the population. Accordingly, the reported incidence of individuals with intakes below the recommended allowance will be overestimated. Therefore, the reported percentages with intakes below the standards should not be taken to be the incidence of nutritional deficiencies in the population. The values are used to test statistically if the incidence of low (below allowance) nutrient intakes was altered by the Cash a la Carte system, and to determine if the incidence of low intakes is greater for certain nutrients than for others.

The frequency distribution of the quantity of foods and fluids (excluding water) consumed are shown in Figure 1. With less than 2000 gm/day as an arbitrary breakpoint, a greater ($P < 0.05$ Chi Square Test) percentage of the COM-S group consumed less than 2000 gm/day in June 1976

(36.0%) than in March 1975 (18.0%). Similar comparisons for the RIK (46.3% in June 1976 vs. 28.6% in March 1975) and the COM-M (19.0% in June 1976 vs. 29.2% in March 1975) groups revealed no statistically significant effects.

Energy intake distributions are shown in Figure 2. Daily energy requirements to maintain an "ideal" body weight are greatly affected by age, body weight, level of activity, and climatic temperature. However, only 11.4% of the RIK group had energy intakes less than 2200 kcal/day in 1975, but 36.6% were below ($P < 0.05$) this level after conversion to COMRAT status. Furthermore, as shown in Table 8, a larger ($P < 0.05$) percentage (87.8%) of the RIKs had energy intakes below the MDA of 3200 kcal in 1976 than in 1975 (65.7%). Therefore, upon conversion to COMRAT status, the entire distribution curve (Fig. 2) for the RIKs was shifted toward lower calorie intakes. In contrast, the caloric intake distribution patterns remained relatively constant for the COM-S and COM-M groups. When data for all six groups were combined, approximately 81.5% of the population had caloric intakes below the MDA of 3200 kcal/day and 76.2% were below the RDA of 3000 kcal/day.

Protein intakes are shown in Figure 3. Conversion from RIK to COMRAT status shifted the distribution toward lower protein intakes. As shown in Table 8, a lower ($P < 0.05$) percentage (42.9%) of the RIKs in March 1975 had protein intakes below the MDA of 100 gm/day than in June 1976 (65.9%). In contrast, fewer ($P < 0.05$) of the COM-M group had protein intakes below 100 gm/day in 1976 (47.6%) than in 1975 (68.8%). Only 3.0% and 5.8% of the combined populations in 1975 and 1976, respectively, reported protein intakes below the RDA of 54 gm/day. However, because of the larger average body weight of our population (76.5 kg), the NRC protein allowance in gm/day should be adjusted according to the reference of 0.8 gm/kg body weight. When this is done, the percentages below the adjusted level of 61 gm/day are 6.8% and 6.3% for 1975 and 1976, respectively.

Fat intakes in gm/day and expressed as percent fat calories are shown in Figures 4 and 5, respectively. The Military and NRC have advocated that the percent fat calories in the total diet should not exceed 40%. In March 1975, 44.4% of the entire population had fat calorie intakes greater than 40% as compared to 56.5% in June 1976 (Table 8). This increase approached statistical significance ($P = 0.054$).

The daily calcium and phosphorus allowances are each 800 mg/day. Although the average calcium intake (Table 4) met or exceeded the allowances for all groups except the COM-M group in 1976, 31.4% (1975 RIK) to 61.9% (1976 COM-M) of the studied populations had calcium intakes below 800 mg/day (Fig. 6 and Table 8). The percentage of the RIK group below the daily allowance for calcium tended to increase from

31.4% in 1975 to 46.3% in 1976; however, this difference was not significant at the 0.05 probability level (P = 0.28). The high concentration of phosphorus in the American diet is reflected by the observation that only 6.0% in 1975 and 10.4% in 1976 of the combined populations had phosphorus intakes below the allowance of 800 mg/day (Fig. 7 and Table 8).

The NRC has also recommended that the Ca:P ratio be within the limits of 1 part calcium to 0.5 parts of phosphorus (1:0.5), and 1 part calcium to 2 parts phosphorus (1:2). As shown in Figure 8 and Table 8, a greater ($P < 0.05$) percentage (34.9%) of the COM-M group exceeded this upper limit (1:2) in June 1976 than in March 1975 (12.5%). In addition, a greater ($P < 0.05$) percentage (26.0%) of the entire population in 1976 exceeded the 1:2 ratio than in 1975 (13.5%).

The distributions of iron intakes are shown in Figure 9. The Military allowance for iron is 18 mg/day compared to 10 mg/day for the NRC. This large difference exists because the Military allowances are directed towards satisfying the needs of the most susceptible sub-group in the military population. The NRC also recognizes that the iron allowance should be greater (18 mg iron/day) for 17 and 18 year olds. Only 3 of our 133 subjects in 1975 were less than 19 years of age. The percentages of combined groups with iron intakes below 10 mg/day were 10.5% and 11.0% in 1975 and 1976, respectively, but 75.9% in 1975 and 82.5% in 1976 had iron intakes below 18 mg/day (Table 8). These data confirm how difficult it is to obtain 18 mg/day of iron without supplementation.

Vitamin A distributions are shown in Figure 10. A high percentage (61.7% in 1975 and 68.8% in 1976) of the combined populations had vitamin A intakes below the 5000 IU/day recommended allowance (Table 8). Vitamin A consumption for all groups studied is a matter of concern, especially when we note that 22.0% to 42.0% of the individuals within the various groups studied had vitamin A intakes below 3000 IU/day, a level thought to be the minimum requirement to prevent all deficiency symptoms in adults (8).

Daily thiamin allowances have been established at 1.5 mg/day by the NRC and 1.6 mg/day by the Military. Thiamin and other B vitamin intakes are often evaluated in reference to energy intake (0.5 mg thiamin/1000 kcal). As shown in Figure 11 and Table 8, the percentage of the RIK population with thiamin intakes below the NRC allowance of 1.5 mg/day tended to increase (P = 0.23) from 71.4% in 1975 to 85.4% in 1976. Thiamin intakes are also a matter of concern because 73.7% and 79.9% of the combined populations in 1975 and 1976, respectively, were below the NRC allowance of 1.5 mg of thiamin per day. These percentages increase to 82.0% in 1975 and 85.7% in 1976 when the slightly higher (1.6 mg/day) Military allowance is used as the standard of comparison. A further indication of the thiamin problem is the observation that approximately

54% of the entire population consumed less than 0.5 mg thiamin per 1000 kcal of energy (Fig. 12 and Table 8).

Riboflavin distributions in mg/day and mg/1000 kcal are shown in Figures 13 and 14, respectively. As shown in Table 8, a greater ($P < 0.05$) proportion of the RIK group had riboflavin intakes below the RDA of 1.8 mg/day in June 1976 (46.3%) than in March 1975 (17.1%). A significantly greater ($P < 0.01$) proportion of the combined population also had riboflavin intakes below the RDA in 1976 (46.8%) than in 1975 (30.1%). The same statistically significant effects of the Cash a la Carte system were apparent when the higher Military allowance of 2.0 mg riboflavin/day is used as the evaluation standard. However, when riboflavin intakes are evaluated on a mg/1000 kcal basis, only 4.5% in 1975 and 9.1% in 1976 of the combined groups had intakes below 0.6 mg riboflavin/1000 kcal of energy consumed.

In contrast to many other nutrients, the percentages of groups with niacin intakes below the NRC recommended allowances (20 mg/day and 6.6 mg/1000 kcal) tended to decrease under the Cash a la Carte system (Fig. 15 and 16). A smaller percentage of the COM-M group ($P < 0.05$) had niacin intakes below the RDA of 20 mg/day in 1976 (Table 8). Despite the improvement, 54.1% of the combined population in 1975 and 42.2% in 1976 were still below the 20 mg/day niacin allowance. The improvement in 1976 approached statistical significance ($P = 0.058$). These trends were not statistically significant when comparisons were made to the slightly higher Military allowance for niacin (21 mg/day). The percentage of RIKs with niacin intakes below 6.6 mg/1000 kcal decreased ($P < 0.05$) from 31.4% in 1975 to 7.3% in 1976, and the percentage of the combined population in 1975 (20.3%) decreased ($P < 0.05$) to 9.1% below 6.6 mg/1000 kcal in 1976.

The NRC and Military allowances for ascorbic acid (vitamin C) are 45 and 60 mg/day, respectively. Although the group means (Table 4) ranged from 59-75 mg/day, a considerable percentage of the population had ascorbic acid intakes below the 45 mg/day allowances (Fig. 17 and Table 8). The combined 1976 population showed a strong trend ($P = 0.055$) towards a greater percentage with intakes below 45 mg/day. The percentage of RIKs with ascorbic acid intakes below the NRC allowances of 45 mg/day tended to increase ($P = 0.25$) from 28.6% in 1975 to 43.9% in 1976.

Source of Daily Nutrient Intake.

The percentages of total daily nutrient intake consumed in the dining hall, at home, at restaurants, and at vendors are shown in Tables 9, 10, 11, and 12, respectively. These mean percentage values were computed from group rather than individual data. The values were influenced by the frequency of dining hall attendance shown in Table 1. The

RIKs consumed 38% of the daily caloric intake at the dining hall in 1975, but only 15% after conversion to COMRAT status in 1976. The COM-S group remained constant at approximately 12% of the caloric intake from the dining hall, whereas the COM-M group increased from 1% to 6% after conversion to the Cash a la Carte system.

Caloric intake data derived from consumptions at home (Table 10), at restaurants (Table 11), and at vendors (Table 12) showed that the RIKs in June 1976, compensated for the decreased caloric intake in the dining hall almost entirely by an increased intake at home (26.7% in 1975 vs. 46.5% in 1976). Conversion to the Cash a la Carte system had little effect on the source of caloric consumption for the COM-S and COM-M groups. The COM-M group, as expected, consumed approximately 75% of calories at home, and only 9% and 11% were derived from restaurants and vendors, respectively. The COM-S group consumed about 49% of the calories at home, 19% at restaurants, and 19% from vendors. It is noteworthy that after conversion to COMRAT status in 1976, the RIKs consumed about the same proportional amounts of calories from sources as those in the COM-S status. The source of other nutrients followed, in general, the same trends as those for energy.

Relative Nutrient Intake From Meals and Snacks.

The percentage of total daily nutrient intake derived from snacks is shown in Table 13. These mean values were also computed from group rather than individual data. The RIKs derived 20% of the total calories from snacks in 1975 but reduced the value to 15% in 1976. In contrast, the RIKs doubled the percentage of calcium, phosphorus, and vitamin A from snacks in 1976. This indicates a marked shift in the type of foods the RIKs consumed as snacks. Such shifts were not observed in the COM-S and COM-M groups. Before Cash a la Carte was introduced, the RIKs obtained a lower percentage of the nutrients, with the exception of calories and carbohydrate, from snacks than the COM-S and COM-M groups. These group differences in snacking patterns were reduced in the June 1976 study, which suggests that selectivity of the quality of snacks increases as dining hall utilization decreases.

Nutrient Intake Per Dining Hall Meal.

The effect of conversion to the Cash a la Carte system on average nutrient intake per dining hall meal is shown in Table 14. All breakfast, lunch, and supper meals were combined and only those subjects from each group who consumed one or more meals at the dining hall were included in these computations. A two-factor analysis of variance (ANOVA) was used to test for significant effects of phase (March 1975 vs. June 1976) and status (RIK, COM-S, and COM-M groups) upon nutrient intake per dining hall meal.

Implementation of the item-pricing component of the Cash a la Carte system in the dining hall significantly (F-test, see Table 14 for P values) reduced energy, protein, fat, carbohydrate, fiber, ash, calcium, phosphorus, iron, sodium, potassium, thiamin (mg), riboflavin (mg and mg/1000 kcal), and ascorbic acid intakes per dining hall meal. In contrast, item-pricing significantly increased niacin intakes per dining hall meal when expressed as mg niacin per 1000 kcal. The remaining variables (% fat calories, Ca:P ratio, vitamin A, and niacin expressed as mg) were not significantly altered by item-pricing. A significant ($P < 0.05$) F-value for status effects was observed only for the variable riboflavin expressed as mg/1000 kcal, and this was due to the COM-M group consuming less than either the COM-S or RIK groups in both phases of the study. There were no significant phase x status interaction effects, which indicate that item-pricing tended to influence the nutrient intakes per dining hall meal of all three groups (RIK, COM-S, and COM-M) in a similar direction. However, the magnitude of the decrease in macronutrient and B-vitamin consumptions per meal appeared to be greater for the COM-S group than for the RIK and COM-M groups.

Item-pricing decreased energy intakes per dining hall meal for the combined groups by an average of 17%. However, the decrement of the intakes was even greater for certain other nutrients. Calcium and riboflavin intakes per dining hall meal decreased by 36 and 30%, respectively. These observations suggest a marked reduction in milk consumption with item pricing. Ascorbic acid intakes decreased by 31%, which indicates a marked reduction in citrus fruit and citrus juice consumption.

Relative Contribution of Various Food Types to Daily Nutrient Intake.

The quantities of various food types consumed per day during meals, snacks, and meals plus snacks from both inside and outside dining hall sources are shown in Tables 15, 16, and 17, respectively. As might be expected, more beverages (both alcoholic and non-alcoholic) are consumed during snacks than during meals, whereas more entrees, miscellaneous, citrus fruits and juices, milk and milk products, and desserts are consumed during meals (Tables 15 and 16).

The average daily milk and milk-product intake of the RIK group markedly decreased from 514.6 gm/day in 1975 to 331.4 gm/day in 1976 (Table 17). As previously noted in Table 4, the average daily calcium intake of the RIK group decreased by 286 mg/day after conversion to COMRAT status. Food type analyses indicates that 252 mg of this decrease in calcium intake can be attributed to a reduction in milk and milk-products consumption during meals and snacks. Similarly, the decreased milk-product consumption of the RIK group in 1976 can account for 0.41 mg/day of the 0.63 mg/day observed decrease in riboflavin intake.

These findings clearly indicate that with a decrease in dining hall attendance, average daily milk and milk-product and, concomitantly, calcium and riboflavin intakes decline markedly.

The previously mentioned indication of a shift in the type of foods consumed during snacks by the former RIKs in June 1976 was documented by food type analyses. Alcoholic beverage intake during snacks and milk intake increased (Table 16). The reduced percentage of total caloric intake derived from snacks (20% - 1975 vs. 15% - 1976, Table 13) is attributable to reduced alcohol consumption (358 kcal - 1975 vs. 91 kcal - 1976). The increased percentage of calcium (7.6% - 1975 vs. 13.4% - 1976) and phosphorus (5.2% - 1975 vs. 10.7% - 1976) from snacks as shown in Table 13 was related to an increased milk-product intake (25 gm - 1975 vs. 54 gm - 1976). This increment, however, did not compensate for the marked decrease in milk consumption of former RIKs during meals (500 gm - 1975 vs. 277 gm - 1976) as shown in Table 15.

The effect of the Cash a la Carte system on food type consumption per dining hall meal is shown in Table 18. The average milk and milk-product intake of the combined group in 1975 was 389.6 gm/meal but markedly decreased to 200 gm/meal in 1976. Milk and milk products contributed 540 mg calcium and 0.79 mg riboflavin per meal in 1975, but only 247 mg calcium and 0.35 mg riboflavin per meal after implementation of the item-pricing system. Non-alcoholic beverage intake increased from 72.4 gm/meal in 1975 to 101.9 gm/meal in 1976.

DISCUSSION

In March 1975, the dining hall utilization of the RIK group (31.6%) was much greater than that of either the COM-S (8.3%) and COM-M (1.0%) groups. These differences were not unexpected because RIKs, in essence, forfeit a portion of their military salary when they choose to skip a meal or choose to eat elsewhere, and, thus, are monetarily committed to consume a significant proportion of their meals in the dining hall. COMRAT status personnel receive a subsistence allowance ($2.55/day) in lieu of a galley pass and, thus, have complete freedom of choice as to where they want to eat their meals. At NAS/Alameda, there were a number of readily accessible Base Exchange and commercially-operated food outlets in competition with the enlisted dining hall, which, unfortunately, was not centrally located and had only a very limited number of parking spaces nearby. The main attraction of the dining hall for COMRAT personnel was the flat-rate-meal-pricing policy (55¢ for breakfast, $1.00 for lunch, and $1.00 for supper). These meal rates were based upon raw food costs and, thus, were considerably less costly than for comparable meals at any of the alternative food outlets.

Conversion of RIK personnel to COMRAT status markedly reduced their dining hall utilization to a level (11.1%) comparable to that of the COM-S group (11.0%) in June 1976. The decreased utilization was due to patrons attending less frequently and to an increased percentage of the population who never went to the dining hall. The results confirm previous findings at Travis Air Force Base where attendance also decreased when RIKs were switched to a subsistence allowance (11). A number of changes were made in conjunction with the Cash a la Carte test to attract more COMRAT status personnel to the dining hall and thereby compensate for the projected decline in attendance by the former RIK group. These changes included major renovations to the dining area to provide a more attractive dining environment, progressive cooking techniques to improve food quality by cooking in small amounts at a rate consistent with customer demand, and menu expansion to provide a greater variety of meat entrees, vegetables, and short-order items to the customer at each meal. All foods offered were item-priced according to raw food cost, and it was anticipated that the opportunity to consume a light meal at a cost less than the normal flat meal rate might attract more customers, especially married personnel, at the noon meal. Although the dining hall utilization rates of the COM-M group increased significantly, and that of the COM-S group increased slightly after implementation of Cash a la Carte, these increases did not completely compensate for the decrease in former RIK patronage. Dining hall utilization of the combined sampled population was 8.7% in June 1976 compared to 11.8% in March 1975. A decline in customer patronage at ashore dining halls is a critical problem to the Navy because it may necessitate a reduction in the number of ashore billets for Navy cooks between periods of sea duty. A severe decline in attendance could result in the closing of ashore dining facilities and thereby threaten the training base for food service personnel necessary for feeding afloat. Therefore, the Cash a la Carte system as tested at NAS/Alameda was not an effective solution to the problem of declining attendance at ashore dining halls.

The item-pricing aspect of the Cash a la Carte system had a number of nutritionally undesirable effects upon food-type selection and, consequently, nutrient intakes per dining hall meal. Average milk and milk-product consumption decreased 49% from 390 gm/meal in 1975 to 200 gm/meal in 1976. Conversely, average non-alcoholic (carbonated and non-carbonated) beverage consumption increased 41% from 72.4 gm/meal to 101.9 gm/meal. The decrease in milk consumption, an excellent source of calcium and riboflavin, was primarily responsible for the marked decrease in calcium (36%) and riboflavin (30%) intakes per dining hall meal. Therefore, when offered a choice of milk, carbonated beverages, or non-carbonated fruit punch, equally priced at 10¢ per glass, dining hall patrons markedly reduced their milk consumption and increased their consumption of less nutritious competing beverages. This undesirable effect of

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11. Wetmiller, J. Technical Report 75-35-OR/SA. NARADCOM, 1975

item-pricing might be minimized if the cost to the customer for a glass of milk was less than that of a glass of a competing beverage.

The consumption of citrus fruits and juices decreased 44% from 17.4 gm/meal to 9.8 gm/meal in 1976. Therefore, patrons were less likely to consume citrus furits and citrus juices, excellent sources of ascorbic acid, when they were item-priced than when they were available at no direct charge to the customer. As a consequence, ascorbic acid intake decreased 45% from 37.2 mg/meal in 1975 to 25.6 mg/meal in 1976. The decreases in protein, fat, carbohydrate, iron, vitamin A, and thiamin intakes per dining hall meal in 1976 were relatively proportional to the 17% decrease in average energy intake per dining hall meal. Although we cannot document why the average energy intake per dining hall meal decreased under the Cash a la Carte system, it may be because the fixed meal rate pricing policy of the old system encouraged customers to consume a full meal to get their money's worth, whereas the item-pricing policy provided the opportunity to consume a less costly small meal. Niacin intakes per dining hall meal were similar in both studies, but when expressed per 1000 kcal, niacin intakes increased in 1976. This suggests that item-pricing enhanced the consumption of breads and cereals. Item-pricing was not effective in reducing the percentage of calories derived from fat sources. The % fat calories could be reduced if the dining hall offered low fat or 2% vitamin A-fortified milk instead of whole milk.

Although the average per dining hall meal intakes of energy, protein, calcium, iron, vitamin A, thiamin, riboflavin, and ascorbic acid decreased when the item-pricing policy was instituted, the mean intakes, with the exception of energy, still exceeded one-third of the military daily allowance for these nutrients. Thus, the average mean consumed by dining hall patrons can be assessed as being nutritionally adequate. However, this does not mean that all customers consumed nutritionally balanced meals when they attended the dining hall. Furthermore, patrons must compensate for the reduction in average nutrient intake per dining hall meal by consuming meals of greater nutritional quality outside the dining hall if they are to maintain the same level of total daily nutrient intake.

Implementation of the Cash a la Carte system increased the percentage of the RIK population with nutrient intakes below the recommended allowances. This effect was statistically significant for energy, protein, and riboflavin. There were also trends, which approached statistical significance, for the percentage of RIKs with calcium, thiamin, and ascorbic acid intakes below allowances to increase under the Cash a la Carte system. These undesirable effects occurred concomitantly with the marked decrease in dining hall utilization and the decline in nutrient intakes per dining hall meal. No significant effects of the Cash a la Carte system on the nutrient intake distributions of the

COM-S group were detected, but it should be recalled that the dining hall utilization of this group remained unaltered after conversion to the new system. Therefore, it would appear that the decline in dining hall utilization was the primary factor contributing to the less desirable nutrient intake patterns of the RIK group after conversion to COMRAT status.

Food type consumption analyses also suggest that all-COMRAT policy had a greater impact upon the former RIKs than the item-pricing aspect of the Cash a la Carte system. Item-pricing of milk reduced the dining hall milk and milk-product consumption of the RIK group by 54 gm/day (391 gm/meal in 1975 vs. 228 gm/meal in 1976 x 0.334 dining hall meals/day in 1976). Total daily milk and milk-product consumption of the RIK group decreased 194 gm/day (525 gm/day in 1975 vs. 331 gm/day in 1976). Therefore, 28% (54 gm ÷ 194 gm x 100) of the decline in total daily milk and milk-product consumption by the RIK group can be attributed to item-pricing of milk in the dining hall, and 72% can be attributed to decline in dining hall attendance following conversion to COMRAT status. The decline in dining hall utilization lowered total daily milk and milk-product consumption because the RIK group consumed much smaller quantities of milk and milk products during meals outside the dining hall (194 gm/meal in 1975 and 113 gm/meal in 1976). Like the RIK group, the COM-S group also consumed more milk and milk products during dining hall meals (397 gm/meal in 1975 and 206 gm/meal in 1976) than during meals consumed away for the dining hall (130 gm/meal in 1975 and 140 gm/meal in 1976).

It is interesting to speculate what the effect on milk and milk-product consumption might have been if the new system had included a la Carte but not the all-COMRAT policy. If one assumes that the dining hall attendance rate of the RIK group in 1975 (0.95 meals/day) had remained unchanged and that item-pricing reduced dining hall milk and milk-product consumption by the same 163 gm/meal, then the total daily milk and milk-product consumption of the RIK group would have decreased by 155 gm/day or 80% of the decline (194 gm/day) actually observed. Therefore, item-pricing of milk in the dining hall at a price identical to that of competing beverages will have a marked undesirable impact upon the total daily milk and milk-product consumption and, subsequently, the calcium and riboflavin intakes of patrons who consume a substantial number of their meals in the dining hall. The effect, of course, would be much less on those patrons who only infrequently eat meals in the dining hall.

In contrast to calcium and riboflavin intakes, the decreases in total daily protein, thiamin, and ascorbic acid intakes of the RIK group were proportionally similar to or less than the recorded decrease in total daily energy intake. Therefore, the decline in protein, thiamin,

and ascorbic acid intakes were related to decreased energy and, presumably, total food consumption by the former RIKs rather than to decreases in their consumption of specific food groups.

There are a number of factors which must be considered before conclusions are drawn from the total daily energy intake data. It is reasonable to assume that groups of adult humans will consume calories in relative proportion to the daily energy requirements to support their individual levels of basal metabolism and physical activity. A consistent surfeit or deficit of even 100 kcal/day will result in a body adipose tissue change of approximately 4.7 kg in a year's time. If one considers the average age (26 years), body weight (76 kg), and level of physical activity (moderate) of the male population at NAS/Alameda, it is reasonable to assume that the actual average daily energy intake was approximately 3000 kcal/day. The reported average energy intake of all 287 subjects studied was 2552 kcal/day. Therefore, the diary-interview technique may have underestimated total daily energy intake by approximately 15%. Since we have estimated that the technique underestimated energy intake per dining hall meal by 8%, it follows that the error was greater than 8% for foods consumed outside the dining hall and may have approached or even exceeded 15%. We must assume, therefore, that this systematic error in measurement contributed to the reported large difference (570 kcal/day) in average total daily energy intakes of the RIK group in 1975 and 1976. Accordingly, we are reluctant to conclude that conversion to the Cash a la Carte system significantly reduced the total daily energy intake of the RIK group. However, the systematic error does not preclude the earlier conclusions because the magnitude of the RIK group's decrease in milk and milk-product consumption and calcium and riboflavin intakes was much greater than the decrease in energy intake.

CONCLUSIONS

1. Conversion of RIK personnel to COMRAT status reduced their utilization of the dining hall from 31.6% in 1975 to 11.1% in 1976. Implementation of item-pricing and renovation of the dining hall increased the dining hall utilization of the COM-M group from 1.0% in 1975 to 5.3% in 1976 but did not significantly increase the dining hall utilization of the COM-S personnel. Therefore, the Cash a la Carte system was not an effective solution to the problem of declining attendance at ashore dining halls.

2. The major nutritional impact of the a la Carte pricing policy was to reduce milk and milk-product consumption and, consequently, calcium and riboflavin intakes per dining hall meal were reduced. Item-pricing also reduced citrus fruit and citrus juice consumption and, consequently, ascorbic acid intake per dining hall meal was reduced. The average energy, protein, phosphorus, iron, and thiamin intakes per

dining hall meal also decreased. Item-pricing and modifications to the menu were not effective in reducing the percentage of calories derived from fat sources. Although nutrient intakes per dining hall meal decreased under the new system, the mean intakes (with the exception of energy) still met or exceeded one-third of the military daily allowance for these nutrients.

3. The combined effects of the Cash a la Carte system to reduce dining hall attendance and nutrient intakes per dining hall meal had an undesirable nutritional impact upon the total daily nutrient intakes of former RIK personnel. Total daily milk and milk-product consumption markedly decreased with a corresponding decrease in calcium and riboflavin consumption. Furthermore, the percentage of RIKs with calcium and riboflavin intakes below the recommended daily allowances increased after implementation of the Cash a la Carte system. Because COM-S and COM-M personnel consumed less than 12% of their daily calories in the dining hall, the changes associated with item-pricing did not significantly affect their total daily nutrient consumptions.

RECOMMENDATIONS

Our recommendations based upon the nutritional impact of the Cash a la Carte system as tested at NAS/Alameda are as follows:

1. Discontinue conversion of all rations-in-kind personnel to commuted rations status, especially at military installations with readily available alternative food outlets.

2. If the a la Carte system is continued, provide milk, particularly low fat or 2% vitamin-A-fortified milk, item priced sufficiently lower than cost (to be below soft drink prices) to stimulate milk consumption and thereby improve calcium, vitamin A, and riboflavin intakes.

3. Give further consideration to modifying the item-pricing system so as to improve the nutritional health of military personnel.

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APPENDIX A

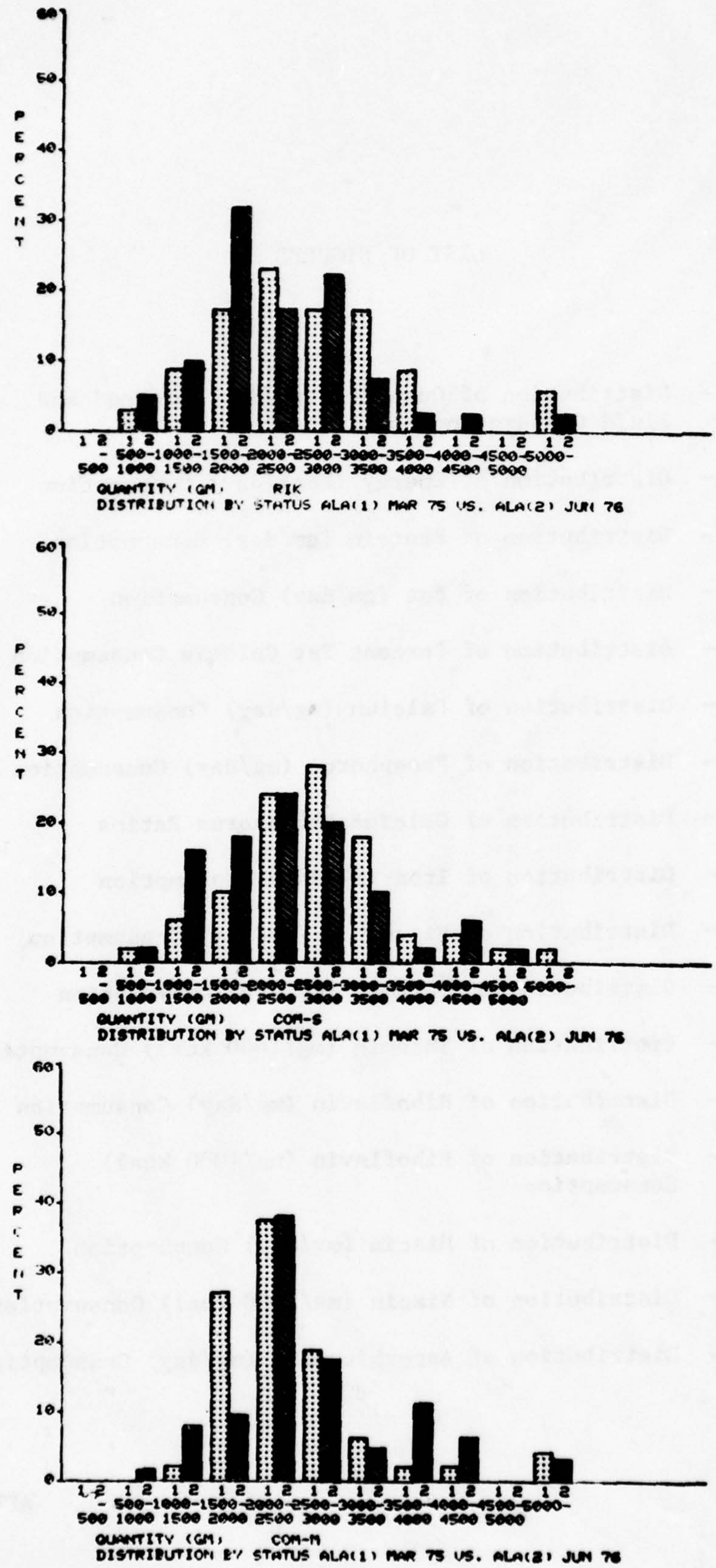

Fig. 1 DISTRIBUTION OF QUANTITY (gm/day) of FOOD AND FLUID CONSUMPTION

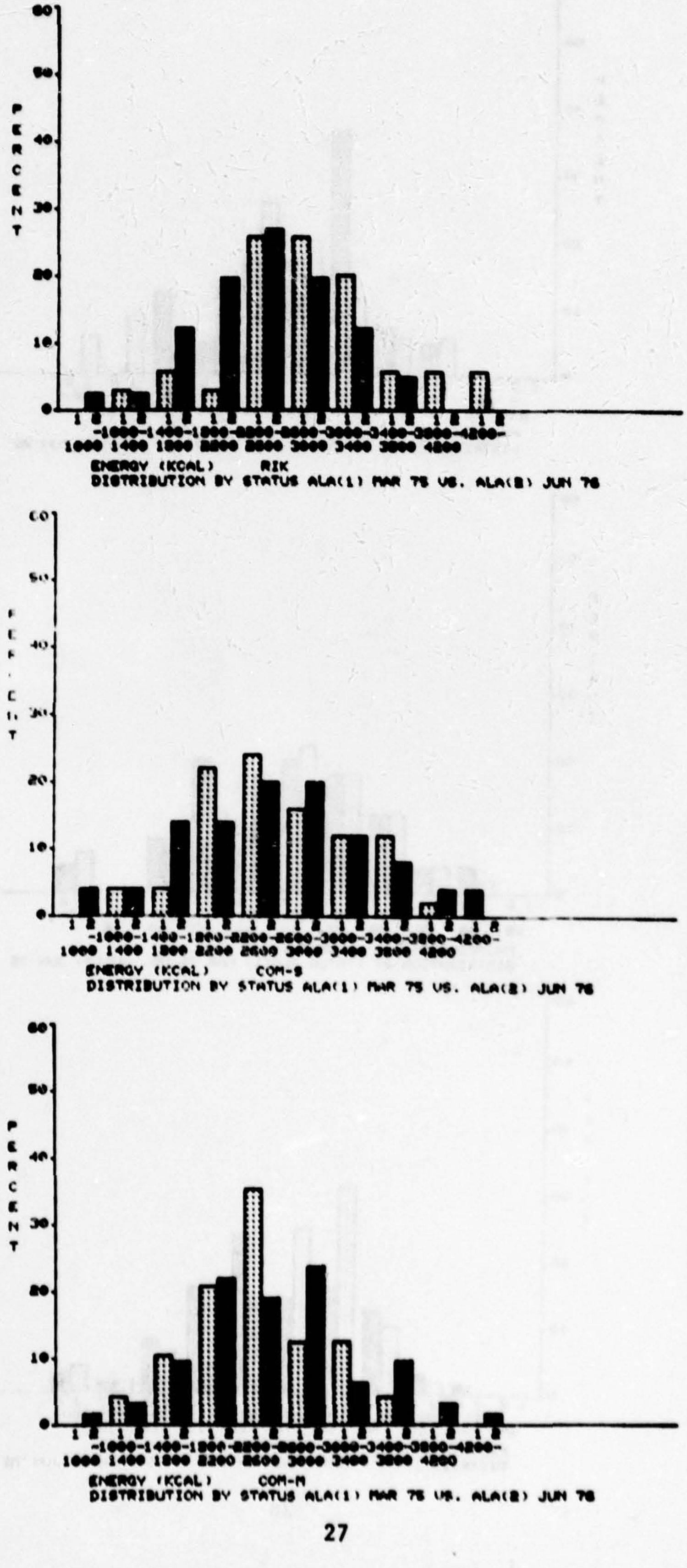

Fig. 2 DISTRIBUTION OF ENERGY (kcal/day) CONSUMPTION

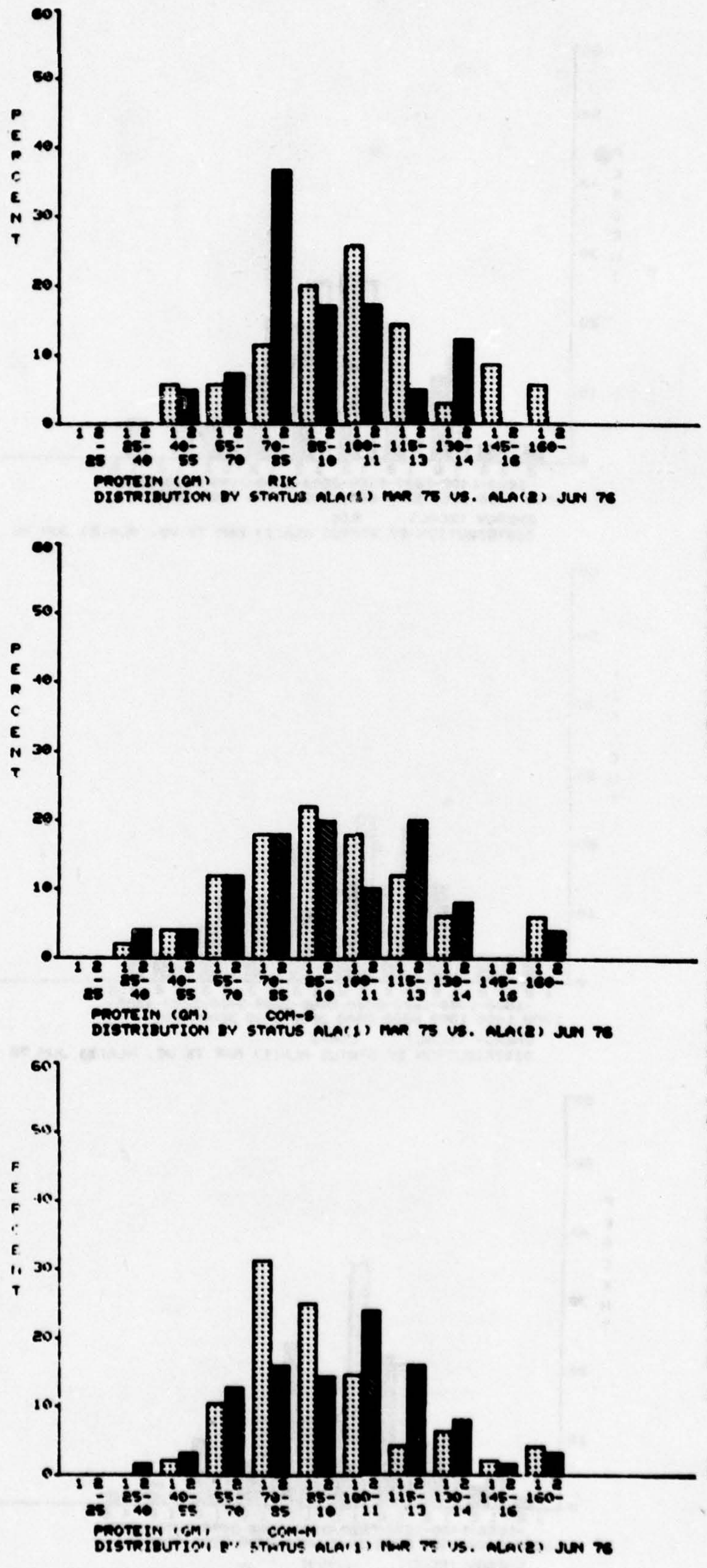

Fig. 3 DISTRIBUTION OF PROTEIN (gm/day) CONSUMPTION

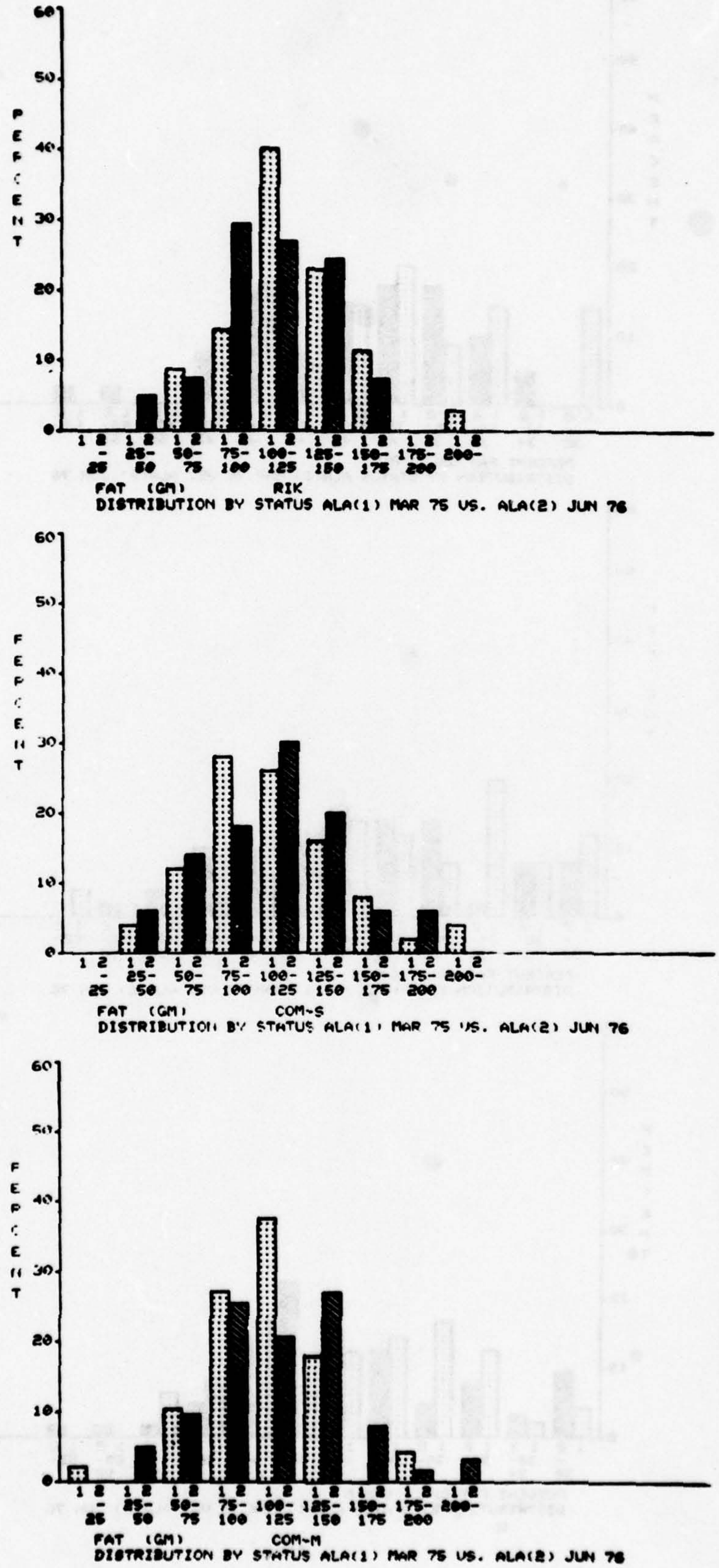

Fig. 4 DISTRIBUTION OF FAT (gm/day) CONSUMPTION

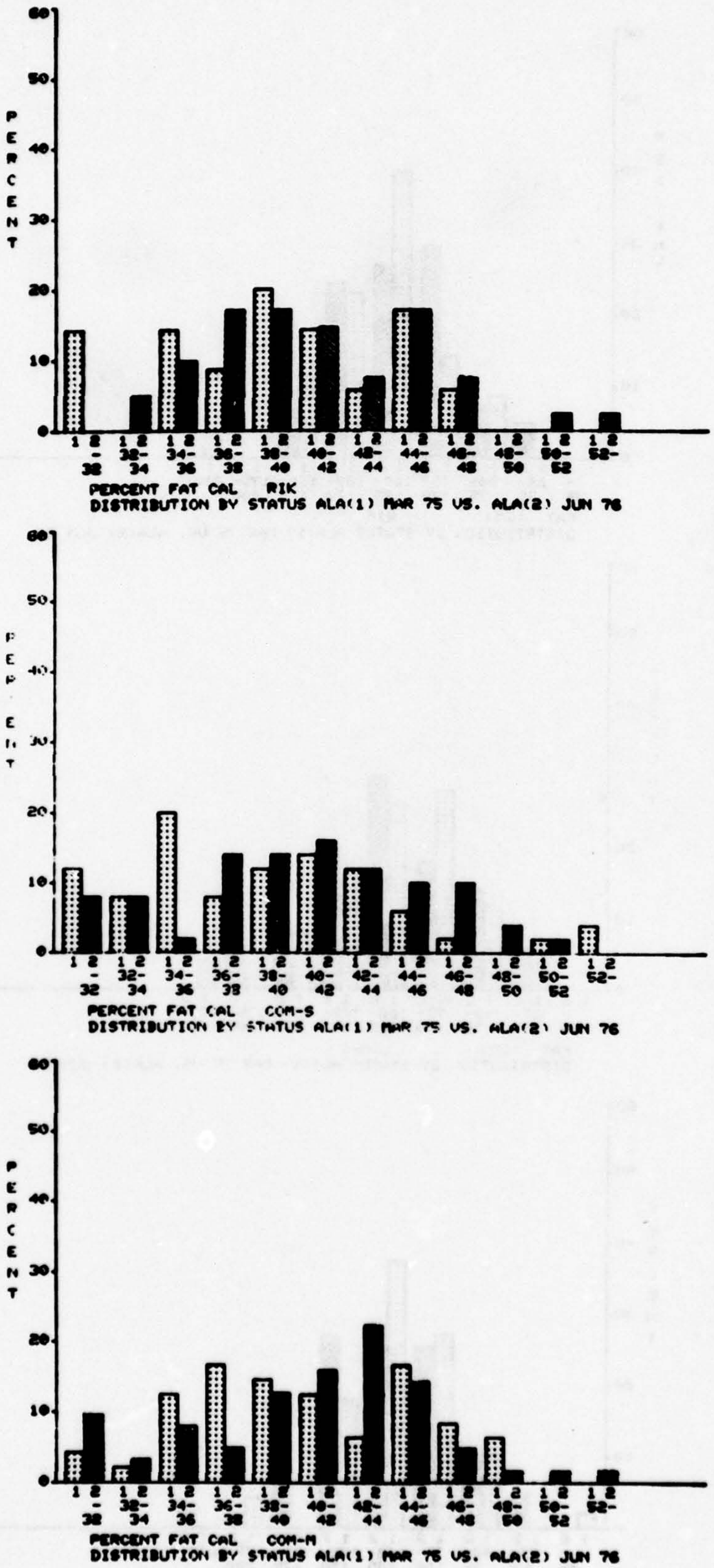

Fig. 5 DISTRIBUTION OF PERCENT FAT CALORIE CONSUMPTION

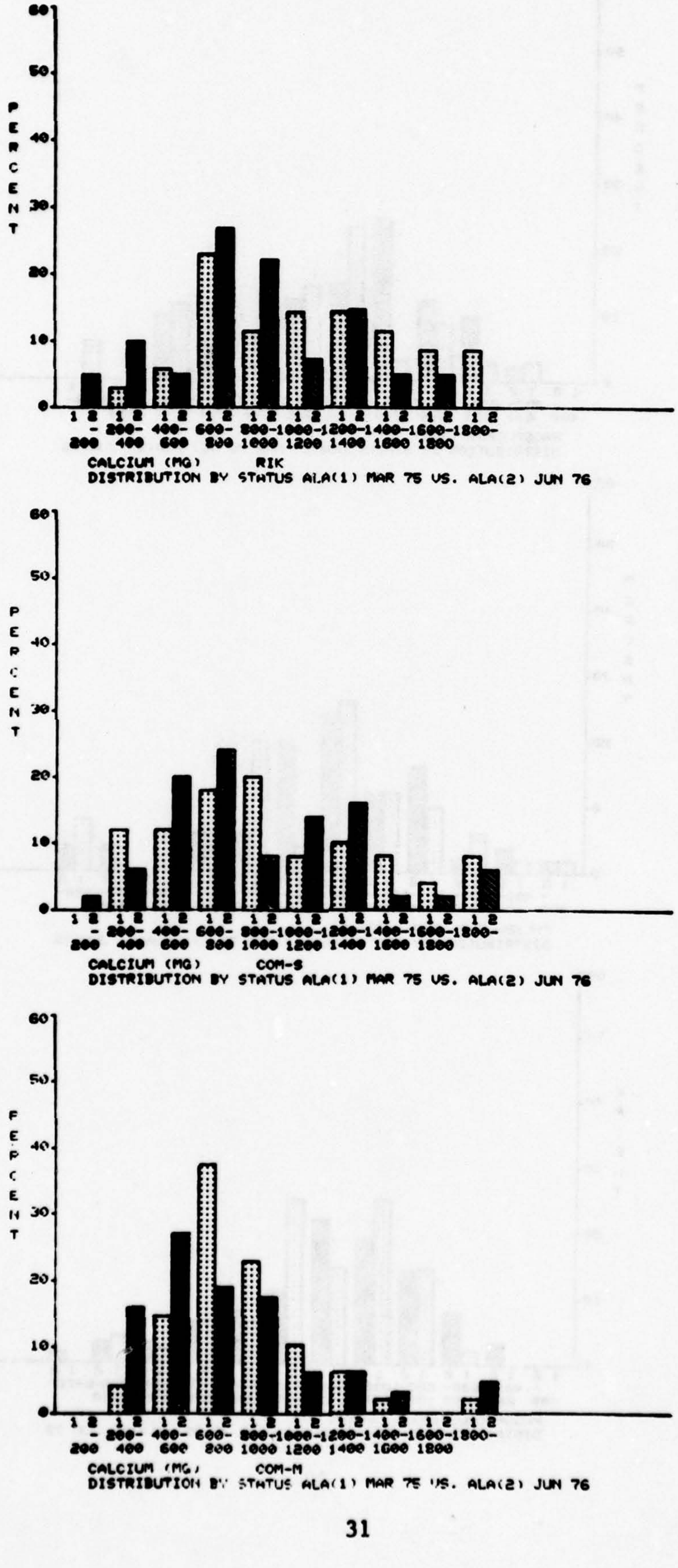

Fig. 6 DISTRIBUTION OF CALCIUM (mg/day) CONSUMPTION

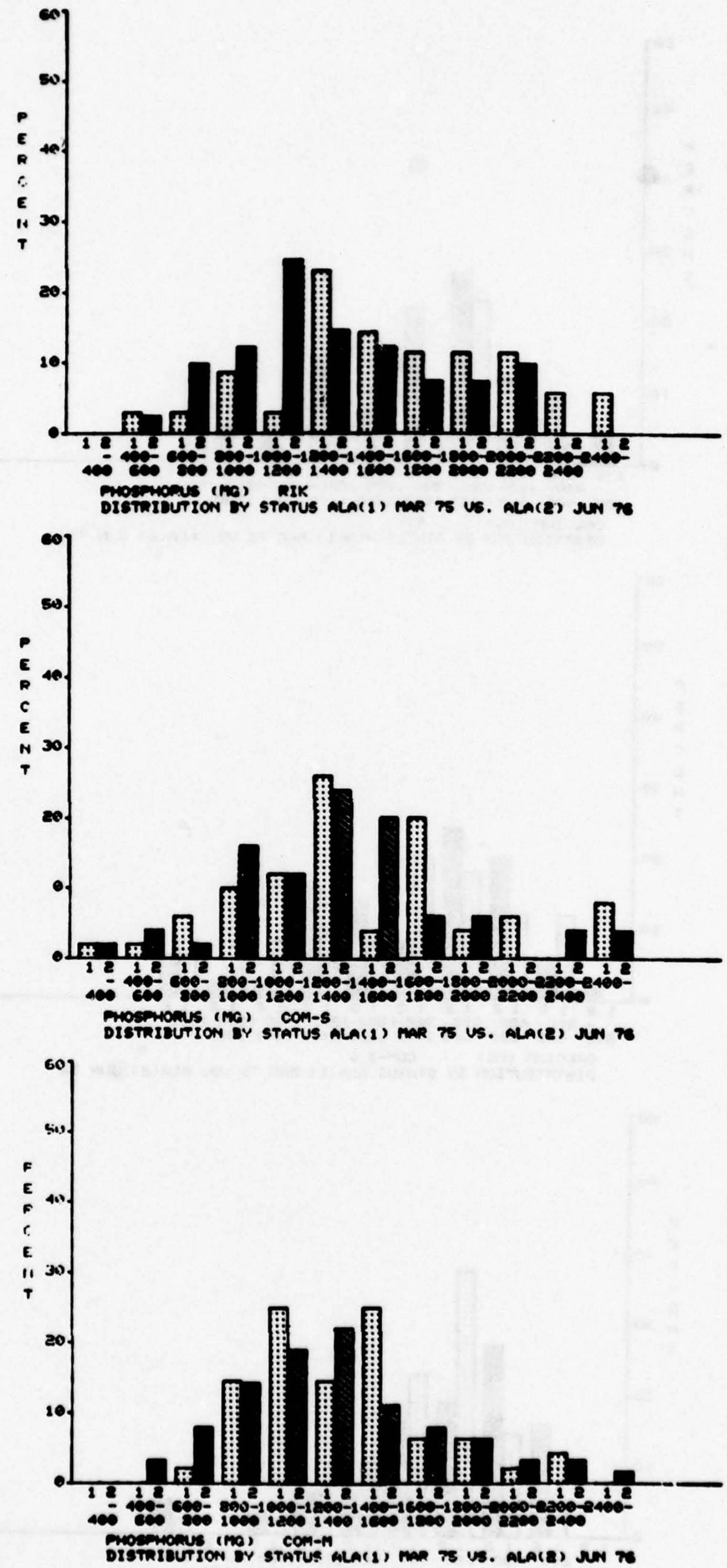

Fig. 7 DISTRIBUTION OF PHOSPHORUS (mg/day) CONSUMPTION

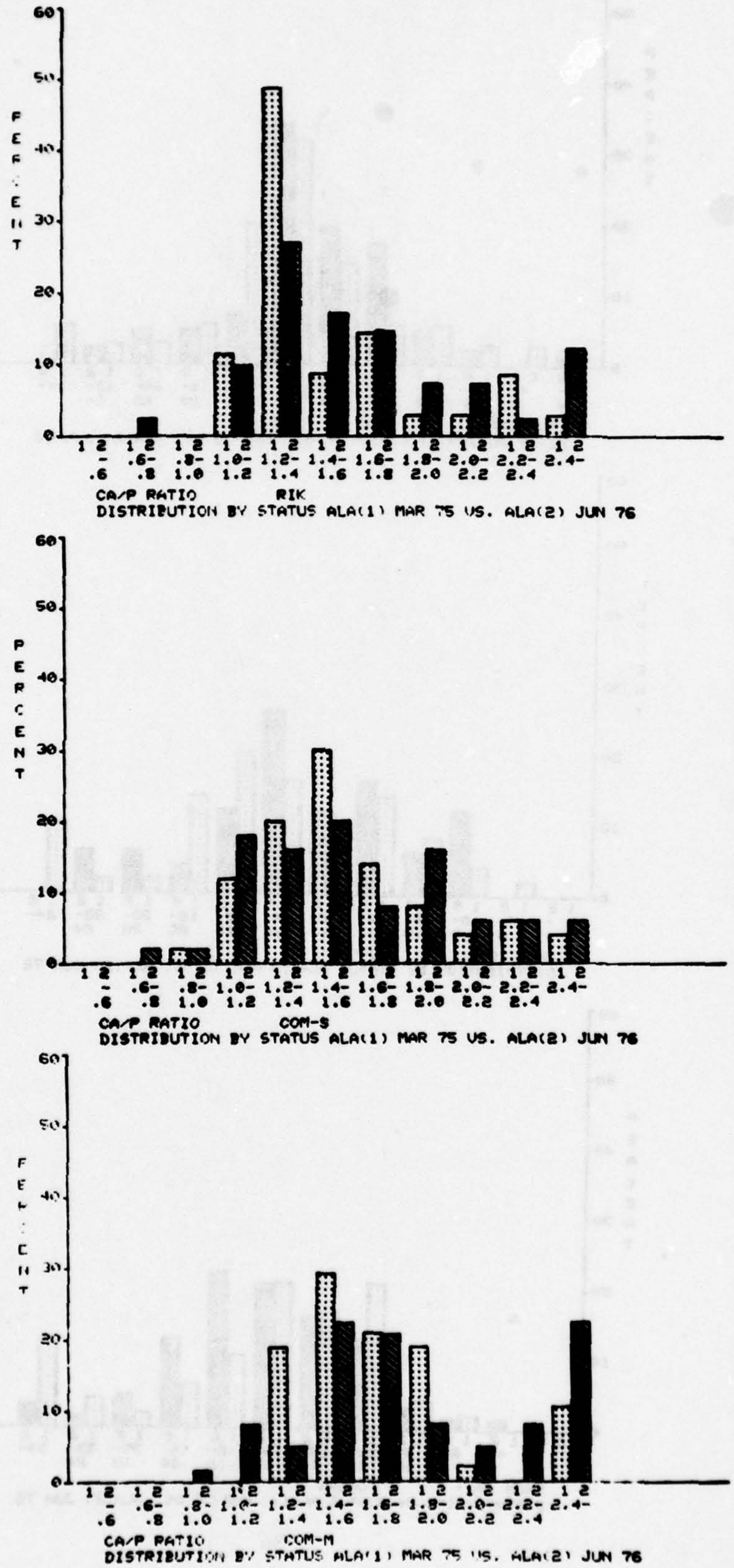

Fig. 8 DISTRIBUTION OF CALCIUM: PHOSPHORUS RATIOS
The figures in the bottom two rows of the abscissa are not the quotient of Ca/P but represent the phosphorus portion of the Ca:P ratio. Space did not permit inclusion of 1:—.

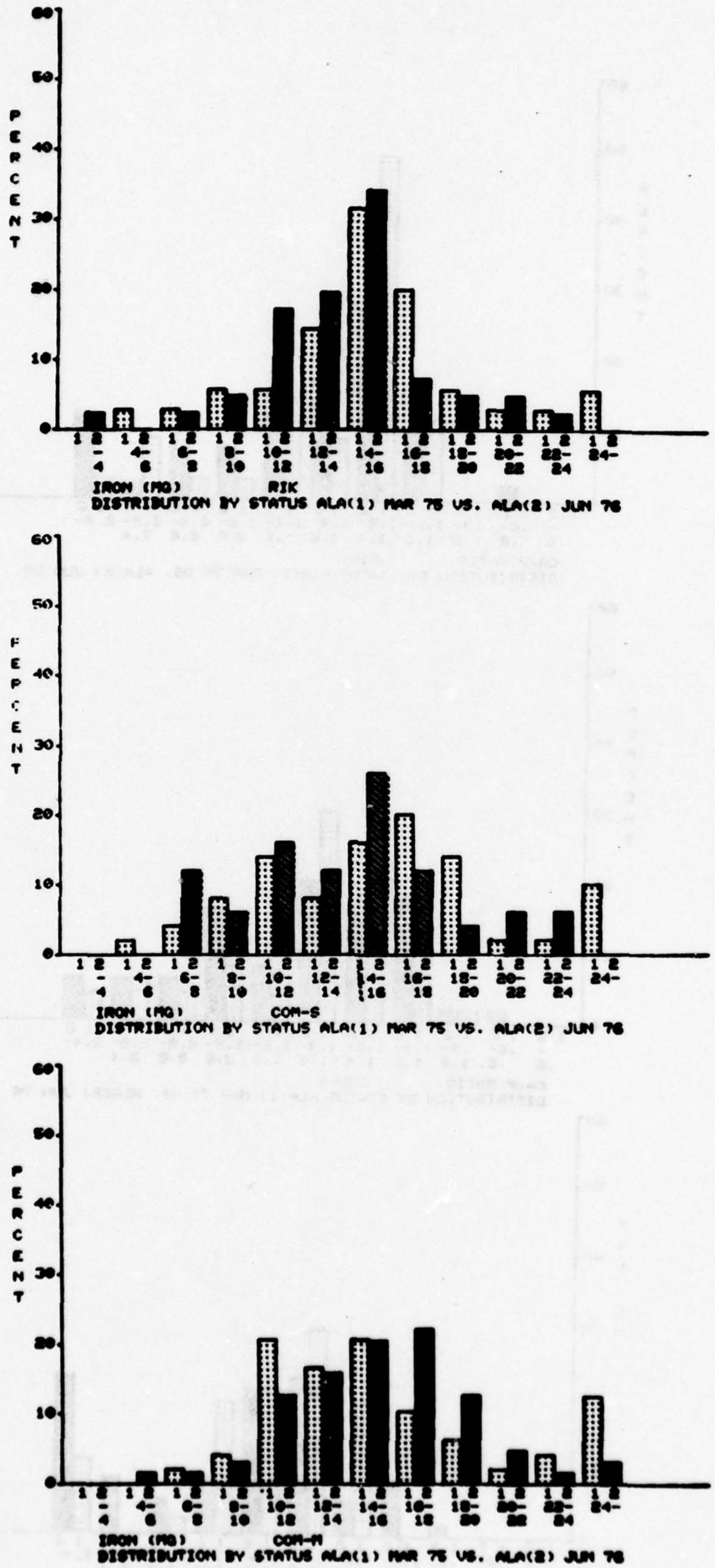

Fig. 9 DISTRIBUTION OF IRON (mg/day) CONSUMPTION

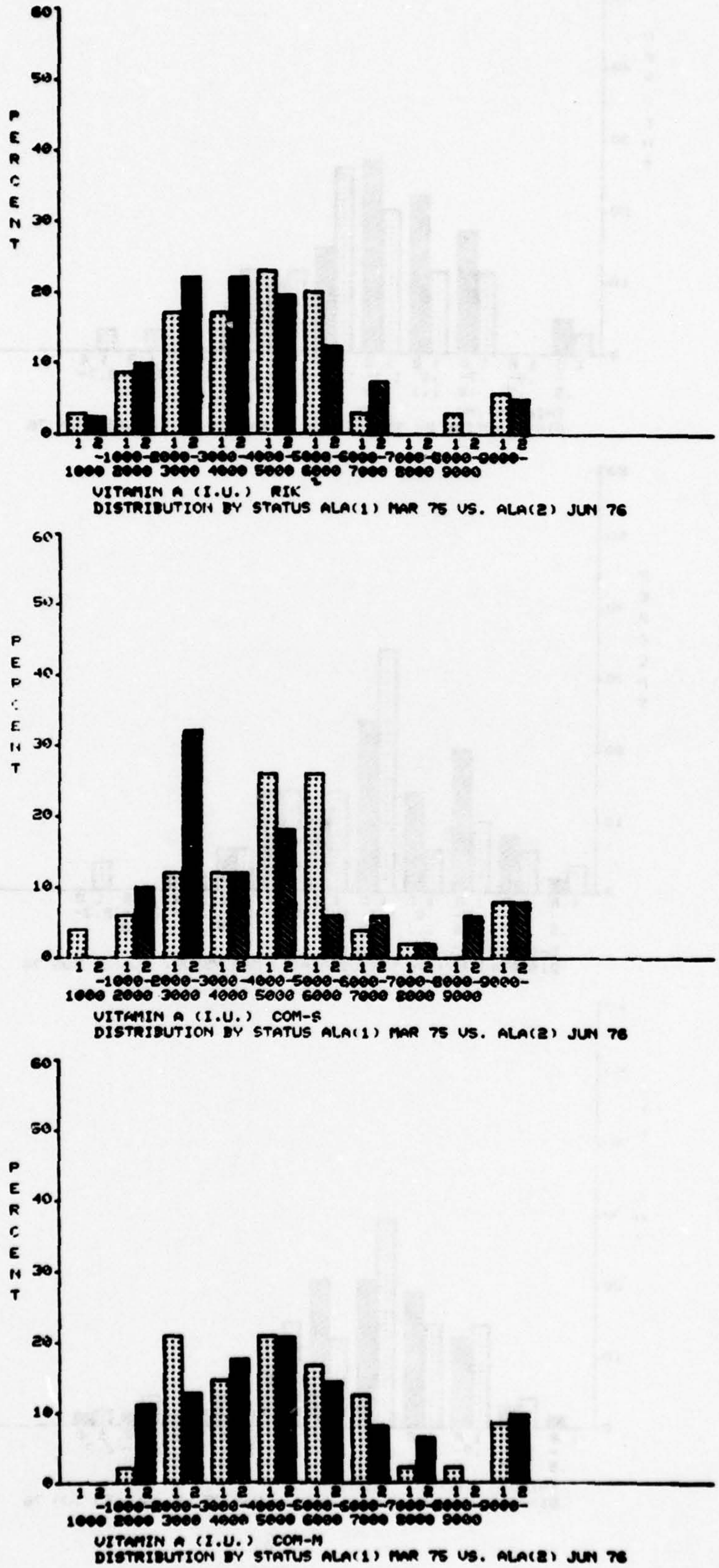

Fig. 10 DISTRIBUTION OF VITAMIN A (IU/day) CONSUMPTION

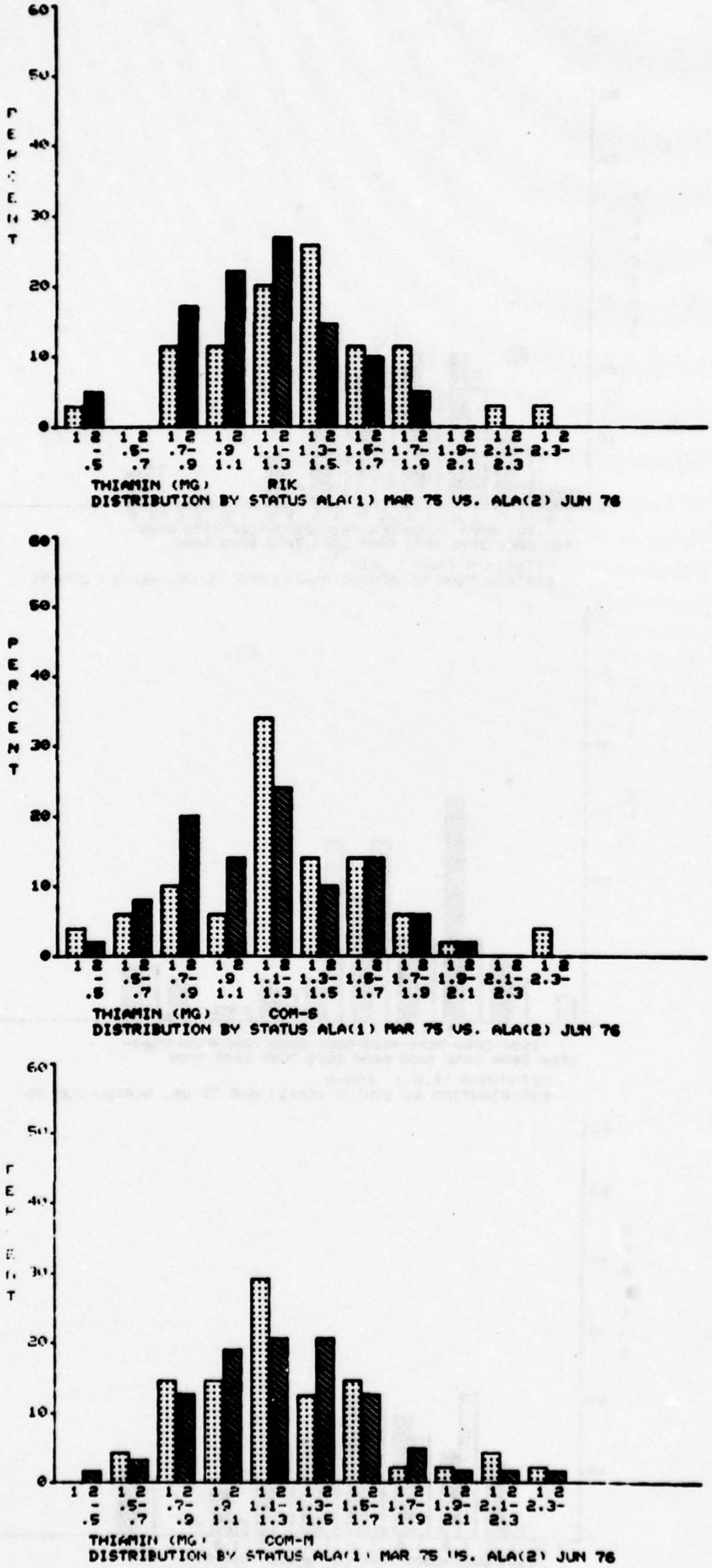

Fig. 11 DISTRIBUTION OF THIAMIN (mg/day) CONSUMPTION

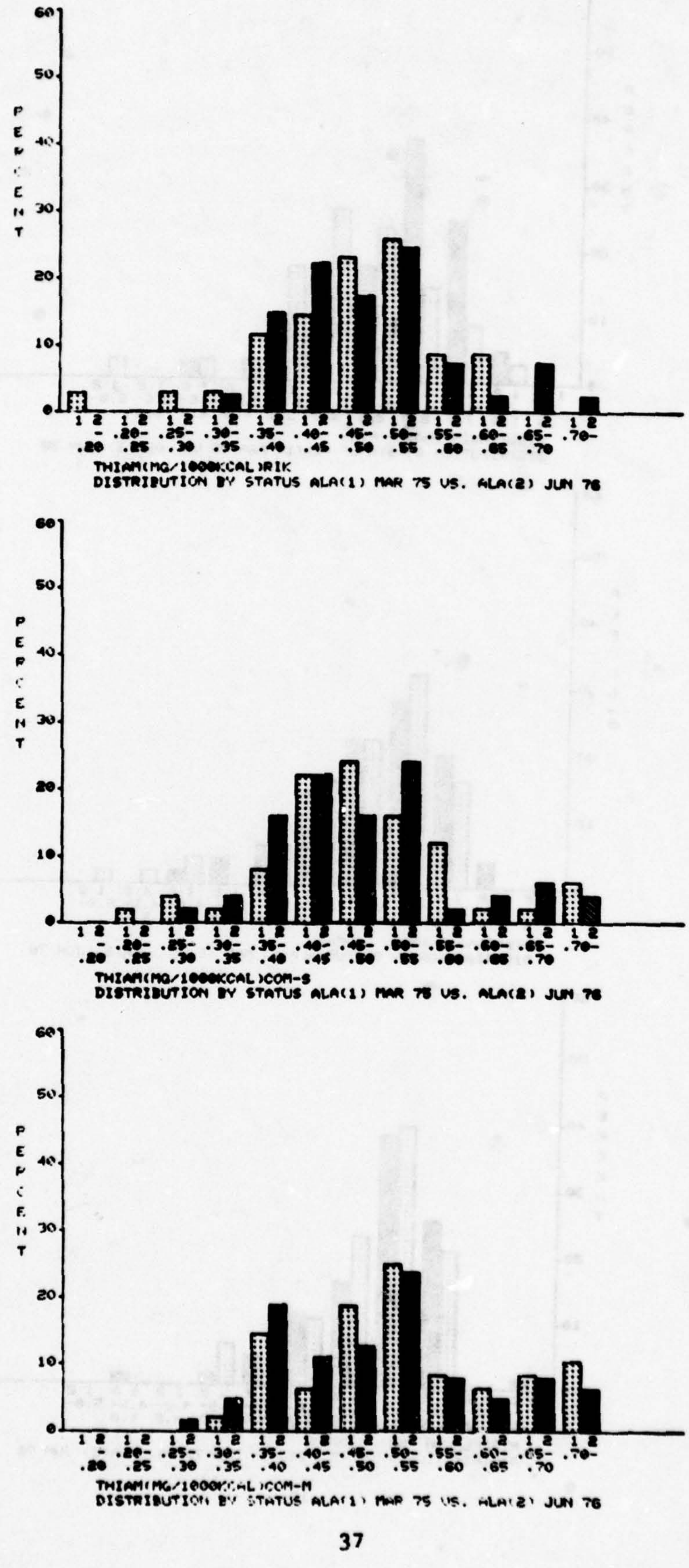

Fig. 12 DISTRIBUTION OF THIAMIN (mg/1000 kcal) CONSUMPTION

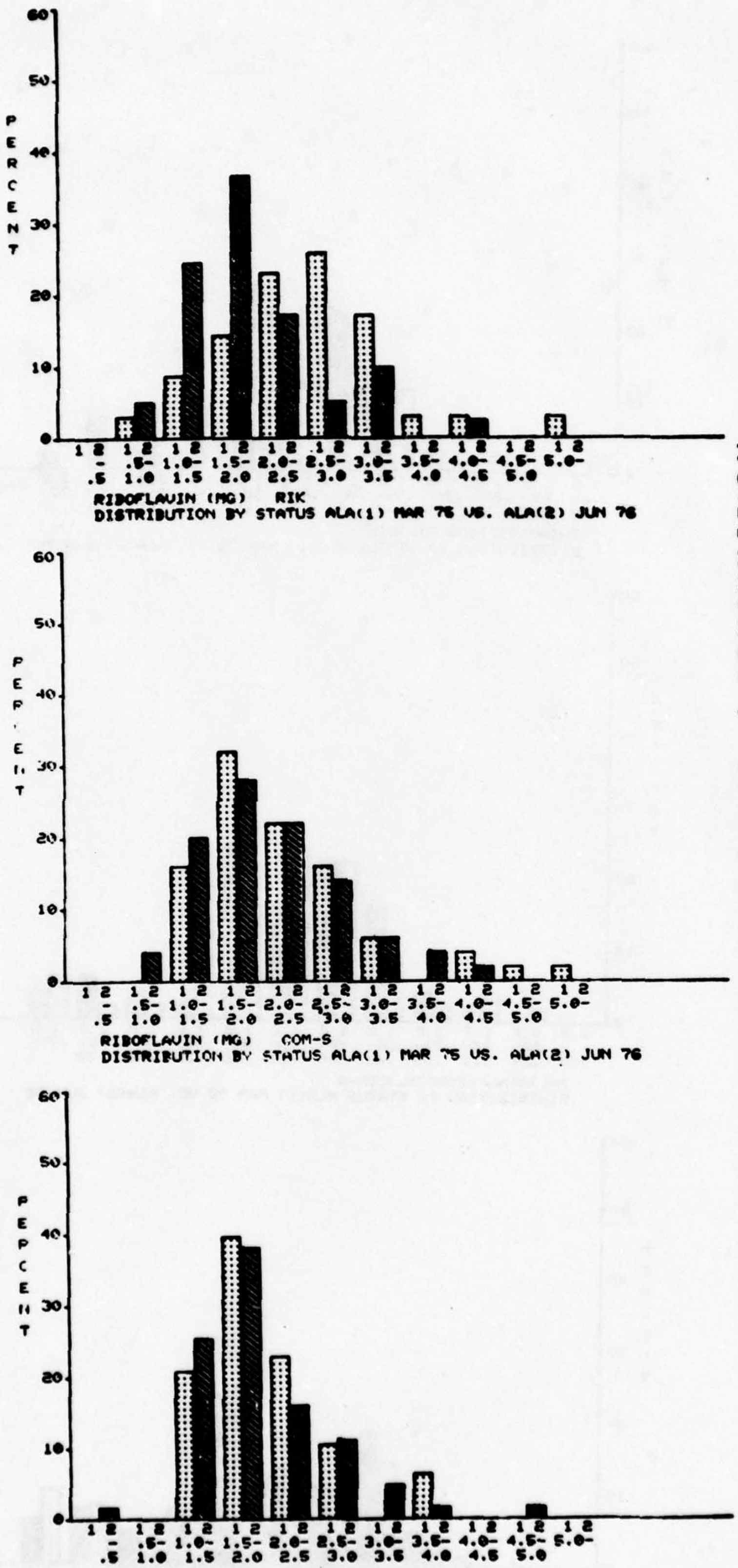

Fig. 13 DISTRIBUTION OF RIBOFLAVIN (mg/day) CONSUMPTION

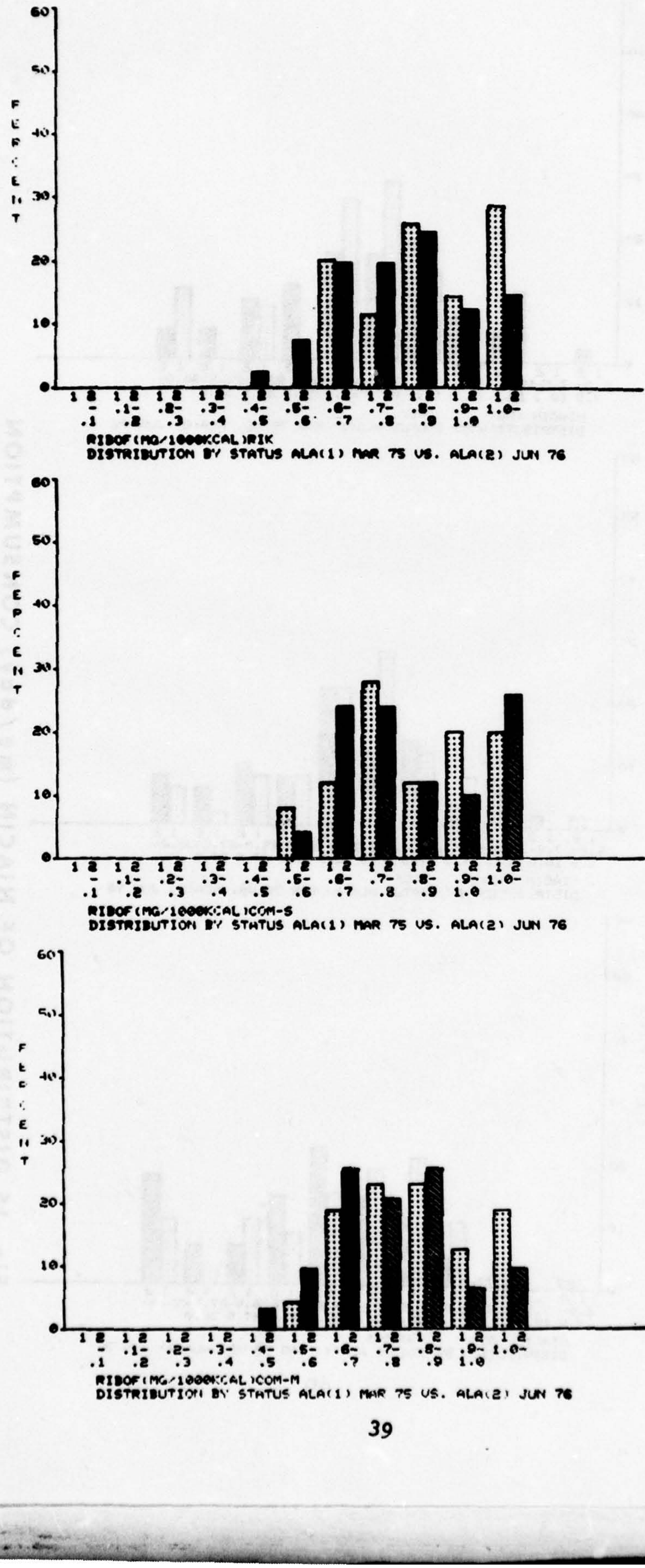

Fig. 14 DISTRIBUTION OF RIBOFLAVIN (mg/1000 kcal) CONSUMPTION

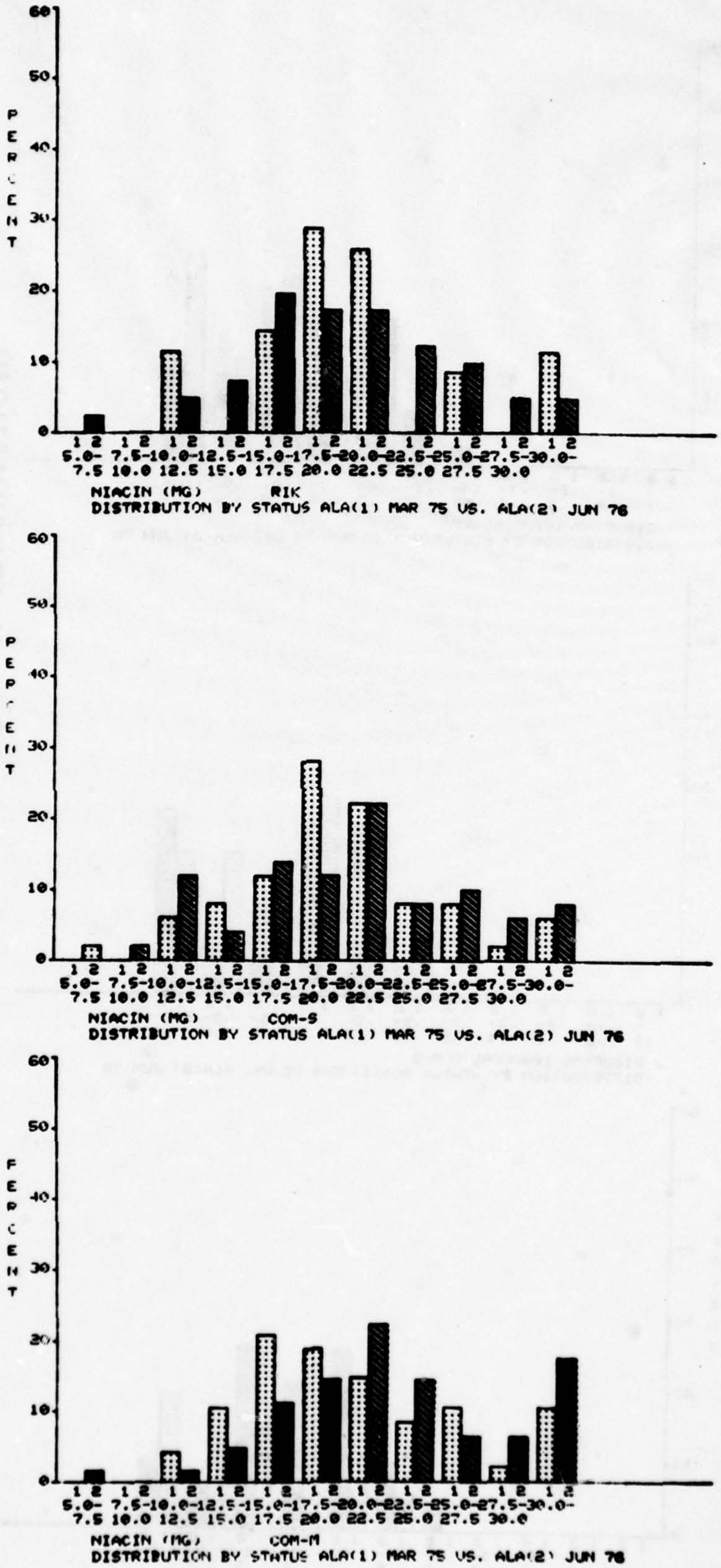

Fig. 15 DISTRIBUTION OF NIACIN (mg/day) CONSUMPTION

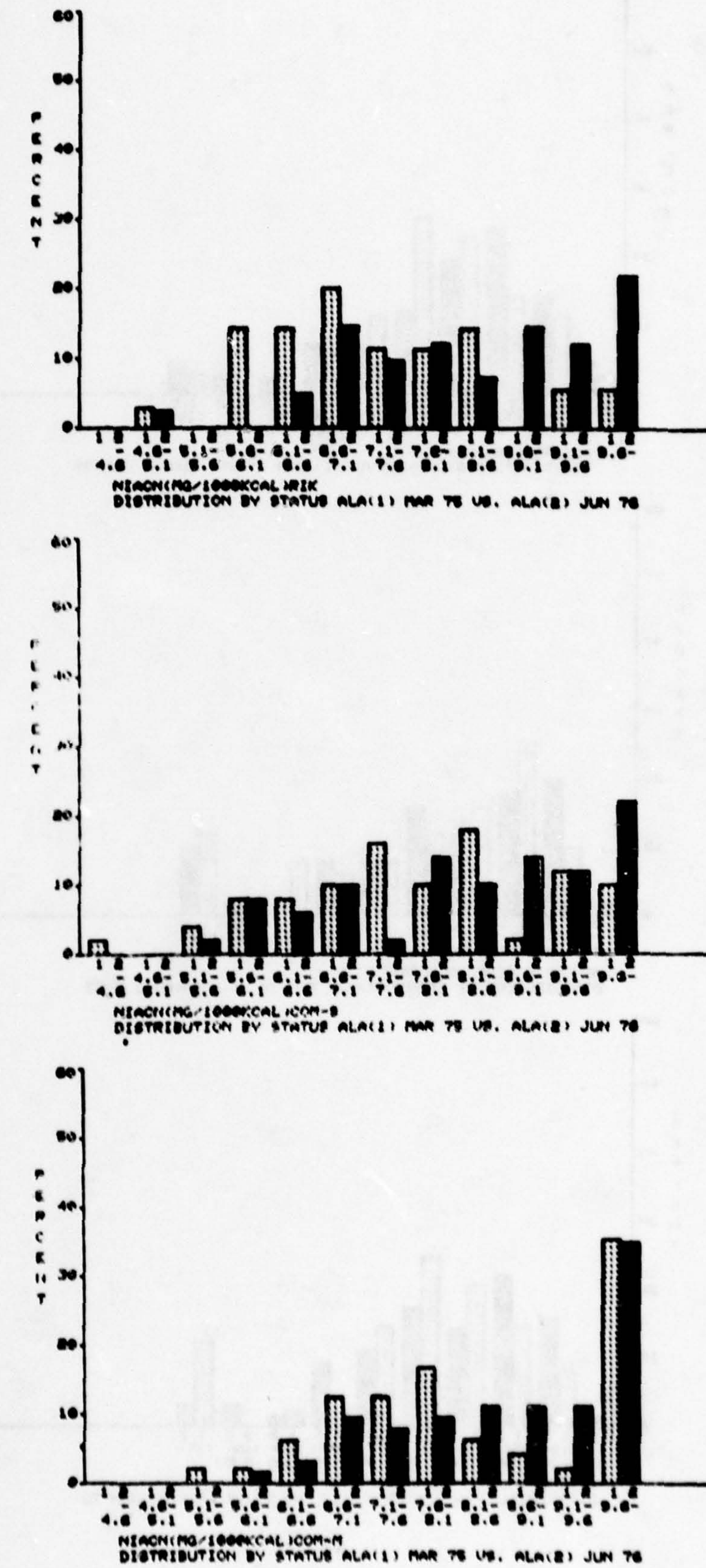

Fig. 16 DISTRIBUTION OF NIACIN (mg/1000 kcal) CONSUMPTION

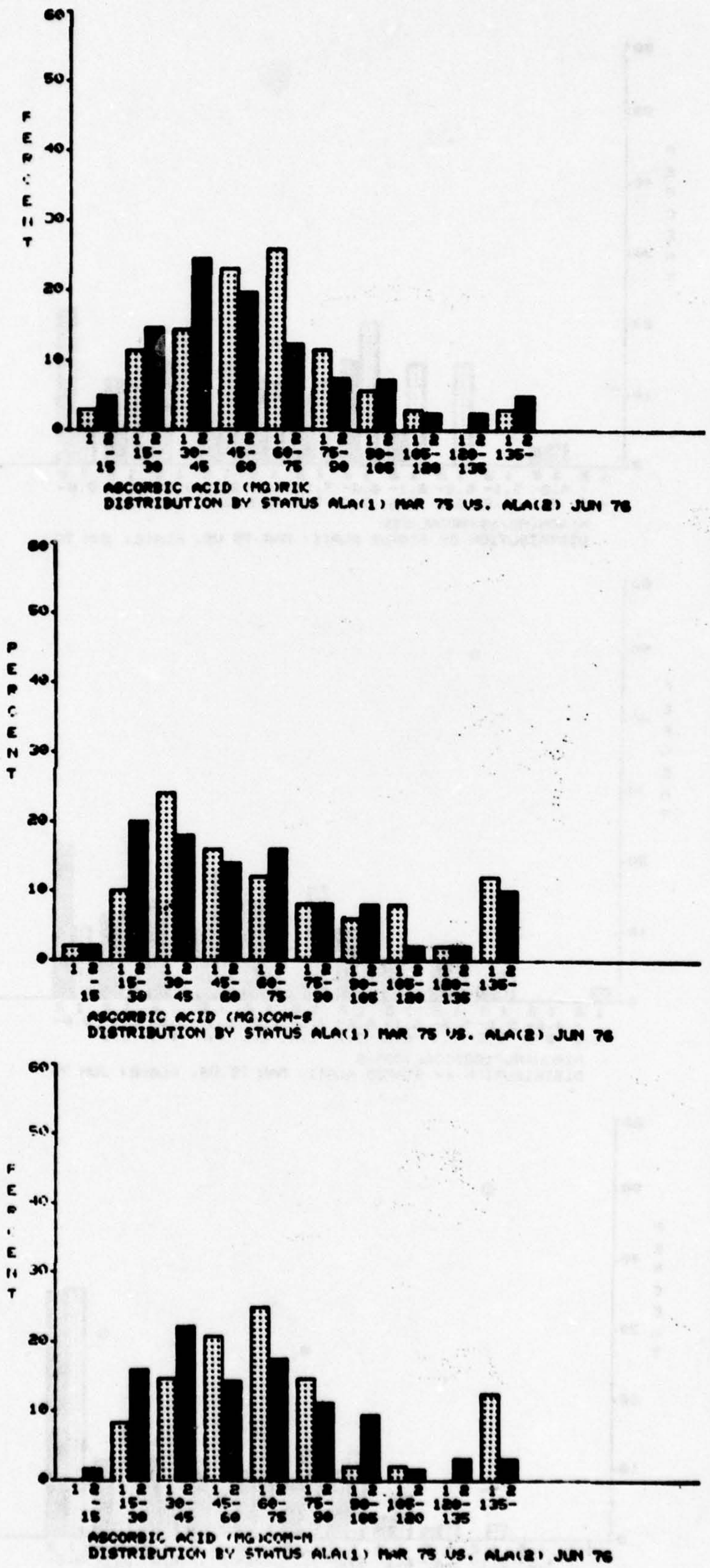

Fig. 17 DISTRIBUTION OF ASCORBIC ACID (mg/day) CONSUMPTION

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APPENDIX B

TABLE 1

EFFECT OF CASH A LA CARTE SYSTEM ON DINING HALL ATTENDANCE

	BEFORE CASH A LA CARTE (MAR 75)[1]		AFTER CASH A LA CARTE (JUN 76)[2]		
GROUP	DINING HALL MEALS PER STUDY	PERCENT UTILIZATION	DINING HALL MEALS PER STUDY	PERCENT UTILIZATION	P VALUE
RIK	16.1 ± 1.83[3]	31.6 ± 3.59 (35)[4]	4.7 ± 1.08	11.1 ± 2.57 (41)	<0.001[5]
COM-S	4.2 ± 1.00	8.3 ± 1.97 (50)	4.6 ± 0.89	11.0 ± 2.12 (50)	0.284
COM-M	0.5 ± 0.23	1.0 ± 0.46 (48)	2.2 ± 0.53	5.3 ± 1.26 (63)	0.001
ALL	6.0 ± 0.82	11.8 ± 1.61 (133)	3.7 ± 0.47	8.7 ± 1.11 (154)	0.817

[1]Maximum of 51 meals per 17-day study. [2]Maximum of 42 meals per 14-day study. [3]Mean ± SEM. [4] Values in parentheses indicate numbers of subjects completing study. [5]Significance of Z-value for percent utilization comparisons (Mann-Whitney U Test).

TABLE 2

EFFECT OF CASH A LA CARTE SYSTEM ON DINING HALL ATTENDANCE PATTERNS

NUMBER OF DINING HALL MEALS	BEFORE CASH A LA CARTE (MAR 75)				AFTER CASH A LA CARTE (JUN 76)			
	RIK	COM-S	COM-M	ALL	RIK	COM-S	COM-M	ALL
0	8.6[1]	50.0	83.3	51.1	41.5[4]	42.0	57.1[4]	48.0
1-5	8.6	26.0	14.7	17.3	26.8[3]	24.0	28.6	26.6
6-10	17.1	8.0	2.1	8.3	17.1	16.0	7.9	13.0
11-15	17.1	2.0	0	5.3	0[4]	8.0	3.2	3.9
16-20	17.1	8.0	0	7.5	7.3	6.0	3.2	5.2
21-25	17.1	4.0	0	6.0	4.9	2.0	0	1.9
26-30	2.9	2.0	0	1.5	2.4	2.0	0	1.3
31-35	5.8	0	0	1.5	0	0	0	0
36-40	2.9	0	0	0.8	0	0	0	0
40-45	2.9	0	0	0.8	0	0	0	0
Once per work day[2]	65.7	16.0	0	23.3	14.6[4]	20.0	7.9[3]	13.6[4]
Number of Subjects	35	50	48	133	41	50	63	154

[1] Values are percentages of the groups attending the number of dining hall meals indicated.
[2] Percentages of the groups attending 11 or more times in the 17-day March 1975 study and 10 or more times in the 14-day June 1976 study. [3] Significantly different from before Cash a la Carte (Chi Square Test), $P < 0.05$; [4] $P < 0.01$.

TABLE 3

EVALUATION OF DAILY DIARY-INTERVIEW TECHNIQUE

NAVAL AIR STATION, ALAMEDA, CA

MARCH 1975

		COMPARISON RATIOS[1]	
NUTRIENT	Mean ± SD	Percent < 1.0[2]	Percent > 1.03[3]
Quantity	0.92 ± 0.30[4]	71.0	29.0
Energy	0.92 ± 0.26	72.6	27.4
Protein	1.01 ± 0.32	54.8	45.2
Fat	0.98 ± 0.28	61.3	38.7
Carbohydrate	0.85 ± 0.32	82.3	17.7
Calcium	0.96 ± 0.56	72.6	27.4
Phosphorus	1.00 ± 0.44	62.9	37.1
Iron	0.93 ± 0.26	67.7	32.3
Vitamin A	0.85 ± 0.33	75.8	24.2
Thiamin	0.96 ± 0.35	61.3	38.7
Riboflavin	0.98 ± 0.48	69.4	30.6
Niacin	1.05 ± 0.52	56.5	43.5
Ascorbic Acid	0.78 ± 0.42	79.0	21.0
All variables ($\bar{x}$)	0.94	68.2%	31.8%

[1]Diary-Interview nutrient Intake ÷ observed nutrient intake.

[2]Comparison ratio less than 1.0 (Diary-Interview < Observed).

[3]Comparison ratio greater than 1.0 (Diary-Interview > Observed).

[4]n = 62 subjects.

TABLE 4

AVERAGE DAILY TOTAL NUTRIENT INTAKE

NUTRIENT	BEFORE CASH A LA CARTE (MARCH 1975) RIK	BEFORE CASH A LA CARTE (MARCH 1975) COM-S	BEFORE CASH A LA CARTE (MARCH 1975) COM-M	AFTER CASH A LA CARTE (JUNE 1976) RIK	AFTER CASH A LA CARTE (JUNE 1976) COM-S	AFTER CASH A LA CARTE (JUNE 1976) COM-M
Quantity (gm)	2804 ± 342[1]	2697 ± 137	2527 ± 149	2247 ± 138	2388 ± 125	2672 ± 151
Energy (kcal)	2945 ± 200	2693 ± 141	2391 ± 78	2375 ± 96	2449 ± 107	2540 ± 102
Protein (gm)	106.1 ± 5.3	99.3 ± 4.8	95.4 ± 4.1	93.5 ± 3.8	96.5 ± 4.3	101.6 ± 4.4
Fat (gm)	119 ± 5.4	114 ± 6.5	106 ± 4.1	107 ± 4.8	109 ± 5.3	114 ± 5.5
% Fat Calories	38.2 ± 1.25	38.3 ± 1.03	40.0 ± 0.94	40.8 ± 0.84	40.2 ± 0.77	40.4 ± 0.77
Carbohydrate (gm)	299 ± 18	262 ± 13	238 ± 10	235 ± 12	231 ± 10	250 ± 10
Fiber (gm)	3.44 ± 0.31	3.48 ± 0.25	3.51 ± 0.23	2.94 ± 0.22	2.78 ± 0.13	3.28 ± 0.22
Ash (gm)	17.7 ± 1.00	16.7 ± 0.82	15.9 ± 0.63	14.7 ± 0.71	15.5 ± 0.76	16.2 ± 0.74
Calcium (mg)	1138 ± 80	996 ± 78	827 ± 43	852 ± 62	917 ± 66	763 ± 52
Phsophorus (mg)	1594 ± 89	1452 ± 86	1357 ± 53	1290 ± 69	1344 ± 71	1320 ± 64
CA:P ratio	1:1.50 ± 0.07	1:1.59 ± 0.06	1:1.74 ± 0.08	1:1.75 ± 0.12	1:1.61 ± 0.07	1:1.93 ± 0.08
Iron (mg)	15.2 ± 0.78	16.0 ± 0.84	16.3 ± 0.97	13.8 ± 0.58	14.2 ± 0.62	15.7 ± 0.66
Sodium (mg)	3220 ± 177	2943 ± 159	1765 ± 130	2572 ± 121	2671 ± 130	2849 ± 139
Potassium (mg)	3124 ± 189	2820 ± 142	1738 ± 105	2385 ± 139	2526 ± 128	2677 ± 126
Vitamin A (IU)	4540 ± 526	4968 ± 452	5414 ± 584	4302 ± 543	4844 ± 538	4940 ± 350
Thiamin (mg)	1.34 ± 0.07	1.31 ± 0.08	1.28 ± 0.06	1.15 ± 0.05	1.16 ± 0.05	1.26 ± 0.05
(mg/1000 kcal)	0.47 ± 0.02	0.48 ± 0.02	0.53 ± 0.02	0.49 ± 0.01	0.49 ± 0.02	0.50 ± 0.02
Riboflavin (mg)	2.57 ± 0.15	2.26 ± 0.13	2.00 ± 0.09	1.94 ± 0.11	2.09 ± 0.11	1.94 ± 0.09
(mg/1000 kcal)	0.89 ± 0.03	0.84 ± 0.02	0.84 ± 0.03	0.82 ± 0.03	0.88 ± 0.04	0.76 ± 0.02
Niacin (mg)	21.0 ± 1.22	20.6 ± 0.87	21.1 ± 1.04	20.1 ± 0.84	20.3 ± 0.94	23.1 ± 0.94
(mg/1000 kcal)	7.29 ± 0.21	7.97 ± 0.27	8.96 ± 0.36	8.71 ± 0.34	8.44 ± 0.24	9.28 ± 0.25
Ascorbic Acid (mg)	62.2 ± 5.7	73.4 ± 7.3	74.8 ± 6.7	58.7 ± 5.6	64.1 ± 5.4	62.0 ± 4.2
No. of Subjects	35	50	48	41	50	63

[1] Mean ± SEM derived from 17 days of observation in March 1975 and 14 days of observation in June 1976.

TABLE 5

RECOMMENDED DAILY DIETARY ALLOWANCE

NUTRIENT	NATIONAL RESEARCH COUNCIL (1974)[1]	BUMEDINST 10110.3E[2] AR 40-25 (1976)
Energy (kcal)	3000	3200
Protein (gm)	54	100
Calcium (mg)	800	800
Phosphorus (mg)	800	800
Iron (mg)	10	18
Vitamin A (IU)	5000	5000
Thiamin (mg)	1.5	1.6
(mg/1000 kcal)	0.5	0.5
Riboflavin (mg)	1.8	2.0
(mg/1000 kcal)	0.6	0.6
Niacin (mg)	20	21
(mg/1000 kcal)	6.6	6.6
Ascorbic Acid (mg)	45	60

[1]Males, 19-22 years of age, weighing 67 kg. [2]Male military personnel (17-25 years of age), moderately active, in a temperate climate.

(See Appendix C for discussion of the differences between the National Research Council and AR 40-25).

TABLE 6

TWO-FACTOR ANALYSIS OF VARIANCE OF TOTAL DAILY NUTRIENT INTAKE DATA

Nutrient	PHASE (df = 1,281)[1]		STATUS (df = 2,281)[2]		INTERACTION (df = 2,281)[3]	
	F-VALUE	P-VALUE	F-VALUE	P-VALUE	F-VALUE	P-VALUE
Quantity	2.04	0.150	0.23	0.999	2.12	0.120
Energy	3.35	0.065	0.82	0.999	4.30	0.014[4]
Protein	0.28	0.999	0.06	0.999	2.05	0.128
Fat	0.13	0.999	0.05	0.990	1.67	0.189
Carbohydrate	5.41	0.020[4]	1.42	0.241	4.82	0.009[4]
Fiber	6.36	0.012[4]	0.91	0.999	0.58	0.999
Ash	3.12	0.075	0.00	0.999	1.96	0.140
Calcium	6.03	0.014[4]	5.24	0.006[4]	1.67	0.189
Phosphorus	5.05	0.024[4]	0.78	0.999	1.65	0.192
Iron	3.92	0.046[4]	2.05	0.128	0.37	0.999
Sodium	4.00	0.044[4]	0.12	0.999	3.04	0.048[4]
Potassium	8.33	0.004[4]	0.12	0.999	2.89	0.056
Vitamin A	0.51	0.999	1.07	0.345	0.07	0.999
Thiamin	4.70	0.029[4]	0.26	0.999	1.00	0.999
Riboflavin	7.40	0.007[4]	2.87	0.057	3.08	0.046[4]
Niacin	0.30	0.999	2.31	0.099	1.19	0.307
Ascorbic Acid	3.54	0.058	1.02	0.362	0.30	0.999
% Fat Calories	3.88	0.047[4]	0.52	0.999	0.74	0.999
Ca:P ratio	4.84	0.027[4]	5.58	0.005[4]	1.01	0.368
Thiamin/1000 kcal	0.10	0.999	2.92	0.054	0.96	0.999
Riboflavin/1000 kcal	2.65	0.100	2.52	0.081	2.45	0.086
Niacin/1000 kcal	8.00	0.005[4]	8.22	0.001[4]	1.90	0.149

[1]Two studies; phase 1 = Mar 75, and phase 2 = Jun 76. [2]Three groups; RIK, COM-S, and COM-M. [3]Phase X status interaction. [4]Significant effect at the P-value indicated.

TABLE 7

MEAN, MEDIAN AND HAMPEL'S ROBUST ESTIMATE OF CENTRAL LOCATION OF TOTAL DAILY NUTRIENT INTAKE DATA

NUTRIENT	PHASE 1 (MARCH 1975)[1]			PHASE 2 (JUNE 1976)[2]		
	MEAN	MEDIAN	ROBUST ESTIMATE	MEAN	MEDIAN	ROBUST ESTIMATE
Quantity (gm)	2664	2416	2426	2467	2279	2314
Energy (kcal)	2651	2533	2534	2467	2433	2427
Protein (gm)	99.7	94.8	95.1	97.8	98.0	95.8
Fat (gm)	112.6	111.3	109.4	101.9	110.1	109.3
% Fat Calories	38.9	39.0	39.3	40.4	40.8	40.7
Carbohydrate (gm)	262.9	255.8	254.5	240.0	238.1	238.6
Fiber (gm)	3.5	3.2	3.2	3.0	2.9	2.8
Ash (gm)	16.7	16.4	16.5	15.6	15.5	15.2
Calcium (mg)	972.1	862.2	880.9	836.7	738.0	760.6
Phosphorus (mg)	1455	1353	1387	1320.0	1280.1	1256.1
Ca:P ratio	1:1.62	1:1.51	1:1.52	1:1.78	1:1.62	1:1.63
Iron (mg)	15.9	15.0	14.9	14.7	14.6	14.5
Sodium (mg)	2952	2916	2891	2717	2600	2629
Potassium (mg)	2870	2765	2799	2550	2478	2480
Vitamin A (IU)	5016	4638	4357	4739	4006	3895
Thiamin (mg)	1.30	1.25	1.26	1.19	1.17	1.17
(mg/1000 kcal)	0.50	0.49	0.49	0.50	0.48	0.48
Riboflavin (mg)	2.25	2.07	2.11	1.99	1.88	1.88
(mg/1000 kcal)	0.85	0.84	0.84	0.81	0.78	0.78
Niacin (mg)	20.9	19.1	19.3	21.4	20.6	20.8
(mg/1000 kcal)	8.15	7.86	7.69	8.85	8.66	8.65
Ascorbic Acid	70.9	60.3	58.7	61.8	56.2	54.8

[1]Combined groups, n = 133. [2]Combined groups, n = 154.

TABLE 8

PERCENTAGE OF POPULATIONS WITH

TOTAL DAILY NUTRIENT INTAKES BELOW RECOMMENDED ALLOWANCES

NUTRIENT	ALLOWANCE	BEFORE CASH A LA CARTE (MARCH 1975)				AFTER CASH A LA CARTE (JUNE 1976)			
		RIK	COM-S	COM-M	ALL	RIK	COM-S	COM-M	ALL
Energy	3000 kcal[1]	62.9	70.0	83.3	72.9	82.9	76.0	79.4	79.2
	3200 kcal[2]	65.7	76.0	91.7	78.9	87.8[3]	82.0	82.5	83.8
Protein	54 gm[1]	5.7	2.0	2.1	3.0	4.9	8.0	4.8	5.8
	61 gm[5]	5.7	8.0	6.3	6.8	4.9	8.0	6.3	6.5
	100 gm[2]	42.9	58.0	68.8	57.9	65.9[3]	58.0	47.6[3]	55.8
% Fat Cal. >40%		42.9	40.0	50.0	44.4	51.2	34.0	61.9	56.5
Calcium	800 mg[1,2]	31.4	42.0	56.3	44.4	46.3	52.0	61.9	54.5
Phosphorus	800 mg[1,2]	5.7	10.0	2.1	6.0	12.2	8.0	11.1	10.4
Ca:P ratio > 1:2		14.3	14.0	12.5	13.5	22.0	18.0	34.9[3]	26.0[3]
Iron	10 mg[1]	11.4	14.0	6.3	10.5	9.8	18.0	6.3	11.0
	18 mg[2]	82.9	72.0	75.0	75.9	87.8	84.0	77.8	82.5
Vitamin A	5000 IU[1,2]	68.6	60.0	58.3	61.7	73.6	72.0	61.9	68.8
Thiamin	1.5 mg[1]	71.4	74.0	75.0	73.7	85.4	78.0	77.8	79.9
	1.6 mg[2]	82.9	82.0	81.3	82.0	87.8	82.0	87.3	85.7
	0.5 mg/1000 kcal[1,2]	57.1	62.0	41.7	53.4	56.1	60.0	49.2	54.5
Riboflavin	1.8 mg[1]	17.1	32.0	37.5	30.1	46.3[3]	42.0	50.8	46.8[4]
	2.0 mg[2]	25.7	48.0	60.4	46.6	65.9[4]	52.0	65.1	61.0[3]
	0.6 mg/1000 kcal[1,2]	0	8.0	4.2	4.5	9.8	4.0	12.7	9.1
Niacin	20 mg[1]	54.3	54.0	54.2	54.1	51.2	46.0	33.3[3]	42.2
	21 mg[2]	60.0	68.0	62.5	63.9	58.5	56.0	46.0	52.6
	6.6 mg/1000 kcal[1,2]	31.4	22.0	10.4	20.3	7.3[3]	16.0	4.8	9.1
Ascorbic Acid	45 mg[1]	28.6	36.0	22.9	29.3	43.9	40.0	39.7	40.9
	60 mg[2]	51.4	52.0	43.8	48.9	63.4	54.0	54.0	56.5

[1]National Research Council (1974). [2]AR 40-24 - BUMEDINST 10110.3E. [3]Significantly different from before Cash a la Carte (Chi Square Test), $P < 0.05$; [4]$P < 0.01$. [5]Adjustment of National Research Council allowance for men weighing 76.5 kg.

TABLE 9

PERCENT OF TOTAL DAILY NUTRIENT INTAKE CONSUMED IN DINING HALL

NUTRIENT	BEFORE CASH A LA CARTE			AFTER CASH A LA CARTE		
	RIK	COM-S	COM-M	RIK	COM-S	COM-M
Quantity	30.06[1]	9.22	0.98	12.11	9.13	4.34
Energy	38.12	12.08	1.35	15.20	11.51	6.38
Protein	47.66	14.28	1.05	17.20	13.40	7.84
Fat	45.37	14.16	1.89	16.82	13.76	7.02
Carbohydrate	36.63	11.54	1.26	14.47	10.82	6.00
Fiber	50.00	11.76	1.28	17.24	14.29	6.06
Ash	51.41	15.06	1.91	17.69	13.55	6.79
Calcium	57.29	18.64	2.05	18.08	13.74	7.08
Phosphorous	54.12	16.98	1.71	15.97	13.02	7.05
Iron	46.75	12.58	1.22	16.67	12.68	7.01
Sodium	48.56	14.03	1.46	17.07	13.03	6.70
Potassium	51.93	15.86	1.76	17.02	13.18	6.20
Vitamin A	59.51	17.24	1.29	18.54	16.26	6.28
Thiamin	49.26	13.74	1.56	15.65	13.04	6.35
Riboflavin	50.58	16.51	1.50	17.01	13.88	6.70
Niacin	38.21	10.95	0.95	14.93	12.32	6.49
Ascorbic Acid	46.88	12.16	1.35	16.95	10.94	4.84

[1]Mean values computed from group rather than individual data.

TABLE 10

PERCENT OF TOTAL DAILY NUTRIENT INTAKE CONSUMED AT HOME

NUTRIENT	BEFORE CASH A LA CARTE			AFTER CASH A LA CARTE		
	RIK	COM-S	COM-M	RIK	COM-S	COM-M
Quantity	36.4[1]	45.2	69.8	44.9	51.5	69.8
Energy	26.7	46.8	78.5	46.5	51.9	73.5
Protein	21.5	46.9	77.7	47.3	51.5	75.5
Fat	18.5	47.8	80.2	46.7	50.5	75.4
Carbohydrate	25.7	45.0	75.9	43.4	50.6	70.8
Fiber	22.2	52.9	81.6	48.3	53.6	75.8
Ash	18.6	48.7	80.9	45.6	53.5	75.3
Calcium	18.3	46.6	79.4	46.2	51.5	75.5
Phosphorus	17.8	48.6	81.4	47.8	52.8	75.5
Iron	18.8	46.5	78.7	45.7	52.1	73.9
Sodium	17.6	45.6	80.6	44.9	52.6	76.0
Potassium	20.6	48.5	79.3	46.8	53.0	75.7
Vitamin A	21.4	57.0	88.8	57.6	63.5	82.1
Thiamin	18.4	49.6	82.0	46.9	54.8	76.2
Riboflavin	21.6	45.5	78.5	45.4	51.2	72.7
Niacin	23.6	46.3	78.2	45.8	51.2	73.6
Ascorbic Acid	25.0	59.5	87.8	49.2	57.8	80.6

[1] Mean values computed from group rather than individual data.

TABLE 11

PERCENT OF TOTAL DAILY NUTRIENT INTAKE CONSUMED AT RESTAURANTS

NUTRIENT	BEFORE CASH A LA CARTE			AFTER CASH A LA CARTE		
	RIK	COM-S	COM-M	RIK	COM-S	COM-M
Quantity	11.1[1]	13.9	6.4	16.0	16.5	7.3
Energy	15.5	18.1	7.8	19.9	20.0	9.8
Protein	15.9	19.4	7.4	21.5	22.7	8.8
Fat	18.5	19.5	8.5	21.5	22.0	10.5
Carbohydrate	14.5	17.7	7.6	18.7	18.6	9.2
Fiber	19.4	20.6	8.6	20.7	21.4	9.1
Ash	14.7	18.7	7.6	19.7	20.6	9.3
Calcium	10.1	15.0	7.5	16.9	18.9	7.6
Phosphorus	14.0	17.3	7.5	19.5	20.9	9.2
Iron	17.5	20.1	7.3	21.7	23.2	9.6
Sodium	15.9	21.1	7.5	21.2	21.0	7.3
Potassium	15.8	18.0	7.9	19.6	20.5	8.5
Vitamin A	11.5	16.1	6.6	14.9	13.6	5.1
Thiamin	14.7	16.8	7.0	20.9	19.1	7.9
Riboflavin	13.1	17.0	7.5	19.1	20.1	8.8
Niacin	19.3	19.4	7.6	21.1	21.7	9.1
Ascorbic Acid	15.6	16.2	6.8	18.6	20.3	8.1

[1]Mean values computed from group rather than individual data.

TABLE 12

PERCENT OF TOTAL DAILY NUTRIENT INTAKE CONSUMED AT VENDORS

NUTRIENT	BEFORE CASH A LA CARTE			AFTER CASH A LA CARTE		
	RIK	COM-S	COM-M	RIK	COM-S	COM-M
Quantity	22.4[1]	31.4	22.7	27.0	22.0	17.8
Energy	19.7	22.8	12.4	18.3	15.9	9.8
Protein	15.0	19.4	9.5	15.1	12.4	7.8
Fat	17.6	18.6	10.4	15.9	14.7	7.9
Carbohydrate	22.8	25.7	15.2	23.0	19.5	9.2
Fiber	11.1	11.8	8.6	13.8	10.7	6.1
Ash	15.3	16.9	9.6	15.6	12.3	8.6
Calcium	14.2	19.5	10.8	18.5	15.4	8.3
Phosphorus	14.1	17.1	9.5	16.6	13.1	7.9
Iron	13.6	10.5	11.0	16.7	12.0	8.9
Sodium	18.0	19.3	10.4	16.8	13.3	7.6
Potassium	11.6	17.2	11.0	16.5	12.8	9.1
Vitamin A	7.5	9.5	3.3	9.3	6.6	6.3
Thiamin	16.9	19.1	9.4	20.0	20.0	11.9
Riboflavin	14.7	21.0	12.0	18.0	14.8	10.8
Niacin	18.9	22.4	12.8	17.2	14.3	10.4
Ascorbic Acid	10.9	12.2	5.4	13.6	10.9	4.8

[1] Mean values computed from group rather than individual data.

TABLE 13

PERCENT OF TOTAL DAILY NUTRIENT INTAKE DERIVED FROM SNACKS

NUTRIENT	BEFORE CASH A LA CARTE			AFTER CASH A LA CARTE		
	RIK	COM-S	COM-M	RIK	COM-S	COM-M
Quantity	39.07[1]	41.08	43.00	31.51	36.73	33.20
Energy	20.40	22.69	17.95	14.78	21.36	17.72
Protein	7.48	10.20	8.42	6.45	10.31	7.84
Fat	6.72	11.50	10.38	8.41	12.84	9.65
Carbohydrate	23.76	26.92	23.63	20.00	26.84	24.00
Fiber	8.33	11.76	8.57	10.35	14.29	12.12
Ash	5.65	11.45	12.74	10.20	12.26	11.73
Calcium	7.64	14.43	16.14	13.38	16.79	13.89
Phosphorus	5.16	11.99	11.23	10.70	13.32	10.45
Iron	7.14	14.47	10.37	7.79	11.27	9.55
Sodium	5.18	8.24	8.01	6.80	10.30	9.41
Potassium	10.85	18.29	19.41	14.26	17.42	15.58
Vitamin A	3.59	7.88	7.18	6.93	7.90	7.19
Thiamin	5.88	12.21	7.81	6.96	13.04	7.94
Riboflavin	13.12	17.41	18.00	13.40	16.75	16.49
Niacin	12.74	16.42	15.64	11.44	14.78	13.42
Ascorbic Acid	10.94	22.97	21.62	10.17	20.31	12.90

[1] Mean values computed from group rather than individual data

TABLE 14

NUTRIENT INTAKE PER DINING HALL MEAL

NUTRIENT	BEFORE CASH A LA CARTE (MARCH 1975) RIK	COM-S	COM-M	ALL	AFTER CASH A LA CARTE (JUNE 1976) RIK	COM-S	COM-M	ALL
Quantity (gm)	855[1]	913	785	869	776	674	728	723[3]
Energy (kcal)	1161	1239	1034	1175	1053	870	1022	976[3]
Protein (gm)	52	56	43	52	49	40	47	45[2]
Fat (gm)	56	64	52	59	54	44	50	49[2]
% Fat Calories	43.7	46.6	43.7	44.8	46.1	44.5	41.0	43.8
Carbohydrate (gm)	114	113	99	111	95	77	97	89[3]
Fiber (gm)	1.9	1.7	1.7	1.8	1.4	1.0	1.2	1.2[3]
Ash (gm)	9.6	9.7	8.3	9.5	7.5	6.4	7.2	7.0[3]
Calcium (mg)	642	675	487	636	439	404	375	405[3]
Phosphorus (mg)	877	927	713	876	609	554	585	581[3]
Ca:P ratio	1:1.48	1:1.70	1:1.86	1:1.61	1:1.72	1:1.68	1:1.75	1:1.72
Iron (mg)	7.5	7.8	6.6	7.5	6.5	5.5	6.8	6.3[3]
Sodium (mg)	1692	1571	1224	1588	1205	1056	1253	1167[3]
Potassium (mg)	1721	1687	1587	1691	1150	1081	1093	1106[3]
Vitamin A (IU)	2854	2937	2205	2806	2707	3073	1947	2583
Thiamin (mg)	0.69	0.71	0.68	0.70	0.54	0.47	0.52	0.51[3]
(mg/1000 kcal)	0.59	0.59	0.65	0.60	0.53	0.56	0.60	0.56
Riboflavin (mg)	1.30	1.37	1.07	1.30	0.97	0.93	0.84	0.91[3]
(mg/1000 kcal)	1.14	1.10	1.03	1.11	0.93	1.08	0.80	0.94[3]
Niacin (mg)	8.7	8.3	6.3	8.2	8.6	7.4	9.1	8.3
(mg/1000 kcal)	7.4	7.0	6.0	7.1	8.1	8.9	8.8	8.6[3]
Ascorbic Acid (mg)	31.1	39.7	53.7	37.2	26.5	24.0	26.4	25.6[3]
Dining Hall Meals/Group	564	212	24	800	192	231	141	564
No. of Subjects	32	25	8	65	24	29	27	80

[1]Mean values computed from the average nutrient intake per dining hall meal of subjects eating one or more meals in the dining hall during the survey period. [2]Significantly different from before Cash a la Carte (two-factor ANOVA, F-test for phase effect), $P < 0.05$; [3]$P < 0.01$.

TABLE 15

QUANTITY (GM/DAY) OF FOOD TYPES CONSUMED DURING MEALS

FOOD TYPE	BEFORE CASH A LA CARTE (MARCH 1975)				AFTER CASH A LA CARTE (JUNE 1976)			
	RIK	COM-S	COM-M	ALL	RIK	COM-S	COM-M	ALL
Beverages, Alcoholic	84.3[1]	136.1	60.0	95.0	117.8	103.3	109.6	109.7
Beverages, Non-alcoholic	287.9	282.4	295.2	288.5	352.3	313.8	458.9	383.3
Milk and Milk Products	500.0	335.2	231.7	341.2	276.7	329.4	223.2	271.9
Desserts	38.4	33.2	27.6	32.6	40.2	28.8	30.6	32.6
Citrus Fruits and Juices	27.4	38.8	40.5	36.4	35.9	35.4	25.3	31.4
Entrees	494.8	481.5	506.6	494.1	465.3	461.8	530.8	491.0
Miscellaneous	262.0	275.5	289.6	277.0	251.3	238.3	307.8	270.2

[1]Mean values computed from group rather than individual data.

TABLE 16

QUANTITY (GM/DAY) OF FOOD TYPES CONSUMED DURING SNACKS

FOOD TYPE	BEFORE CASH A LA CARTE (MARCH 1975)				AFTER CASH A LA CARTE (JUNE 1976)			
	RIK	COM-S	COM-M	ALL	RIK	COM-S	COM-M	ALL
Beverages, Alcoholic	681.7[1]	426.8	235.7	424.9	159.3	306.7	260.7	248.7
Beverages, Non-alcoholic	338.2	526.3	684.4	533.9	421.0	400.7	592.7	484.6
Milk and Milk Products	24.6	58.7	55.0	48.4	54.7	69.1	41.1	53.8
Desserts	22.1	25.6	28.5	25.7	16.4	20.6	23.7	20.8
Citrus Fruits and Juices	10.8	28.9	30.8	24.8	8.3	21.0	14.8	15.1
Entrees	12.4	20.8	13.1	15.8	16.4	21.7	24.8	21.6
Miscellaneous	19.4	27.4	28.2	25.6	31.8	37.5	27.9	32.1

[1]Mean values computed from group rather than individual data.

TABLE 17

QUANTITY (GM/DAY) OF FOOD TYPES CONSUMED DURING MEALS AND SNACKS

FOOD TYPE	BEFORE CASH A LA CARTE (MARCH 1975)				AFTER CASH A LA CARTE (JUNE 1976)			
	RIK	COM-S	COM-M	ALL	RIK	COM-S	COM-M	ALL
Beverages, Alcoholic	766.0[1]	562.9	295.7	519.9	277.1	410.0	370.3	358.4
Beverages Non-alcoholic	626.1	808.7	979.6	822.4	773.3	714.5	1051.8	867.9
Milk and Milk Products	524.6	393.9	286.7	389.6	331.4	398.5	264.3	325.7
Desserts	60.5	58.8	56.1	58.3	56.6	49.4	54.3	53.4
Citrus Fruits and Juices	38.2	67.7	71.3	61.2	44.2	56.4	40.1	46.5
Entrees	507.2	502.3	519.7	509.9	481.7	483.5	555.6	512.6
Miscellaneous	281.4	302.9	317.8	302.6	283.1	275.8	335.7	302.3

[1] Mean values computed from group rather than individual data.

TABLE 18

QUANTITY (GM) OF FOOD TYPES CONSUMED PER DINING HALL MEAL

FOOD TYPE	BEFORE CASH A LA CARTE (MARCH 1975)				AFTER CASH A LA CARTE (JUNE 1976)			
	RIK	COM-S	COM-M	ALL	RIK	COM-S	COM-M	ALL
Beverages, Non-alcoholic	69.6[1]	82.6	48.1	72.4	95.1	88.2	134.6	101.9
Milk and Milk Products	391.4	396.7	286.1	389.6	228.5	205.9	149.1	200.0
Desserts	26.4	41.3	29.7	30.5	37.4	23.3	32.2	30.4
Citrus Fruits and Juices	13.7	23.8	46.5	17.4	15.5	8.0	4.6	9.8
Entrees	229.7	229.5	186.6	228.3	231.8	196.4	258.6	223.9
Miscellaneous	153.7	185.4	159.1	162.3	146.9	108.3	128.7	126.8
Dining Hall Meals/Group	564	212	24	800	192	231	141	564

[1] Mean values computed from group rather than individual data.

APPENDIX C

A Comparison of the Recommended Dietary Allowances (National Research Council vs Daily Dietary Allowances (Nutritional Standards for Military Personnel).

Throughout this report comparison has been made of the nutrient intake of the subjects at NAS, Alameda with the Recommended Dietary Allowances (RDA) promulgated by the National Research Council and the Daily Dietary Allowances (MDA) listed in the Tri-service Regulation "Nutritional Standards" (AR 40-25, BUMEDINST 10110.3E, AFR 160-95). In the text the impression is obtained that these two standards or allowances are radically different. The recommended levels for daily nutrient intake are given in Table 5. In essence, the recommendations contained in the MDA differ from those in the RDA for only three nutrients: energy, protein and ascorbic acid.

"Nutritional Standards," DOD Manual 1338.10-M dated 19 June 1972, directed that the nutritional standards for the daily food allowance for personnel of the military services be established. It further stated that all levels of nutrients adopted as standards would be based on the latest National Academy of Sciences/National Research Council's publication, *Recommended Dietary Allowances*. It was further stated that the standards would reflect the requirements of men and women between the ages of 17 and 25. The RDA cited in Table 5, addresses only males between the ages of 19 and 22 years. It should be noted that the techniques used for development of the RDA have varied slightly with each committee responsible for developing the new Recommended Dietary Allowances. The fact that the committee membership, preparing the new additions varies from edition to edition, explains the differences in the approaches and, to a degree, in the allowances established. It also helps to emphasize the difficulty in establishing allowances which will satisfy the needs of all people, without oversupplying some and undersupplying others.

There is a difference in the populations being addressed by the RDA from those being addressed by the MDA. For example, the males being addressed in the 19 to 22 year age group, by the RDA, are said to be 67 kg of weight and 172 cm in height, living in a moderate environment with light to sedentary physical activity predominating with periods of moderate activity. The reference man in the RDA for the next age group given, i.e., 23 to 50 years is 70 kg in weight and 172 cm in height, with a similar degree of physical activity and environmental exposure. In establishing an MDA for the 17 through 25 year age group, no attempt was made to define the height/weight characteristics of the reference male. However, in all surveys conducted by the U.S. Army

Medical Research and Nutrition Laboratory (USAMRNL) and the Letterman Army Institute of Research, the average height has exceeded that of the RDA reference man, usually by 2 cm and sometimes by as much as over 4 cm. The average weight has exceeded the weight for the adult males in the 19-22 year and the 23-50 year group, cited in the RDA. While the increased weight observed in the military could be ascribed to an increase percentage of body fat, it could equally be ascribed to an increase in the lean body mass as a reflection of the physical selection process required in the acceptance of personnel for the military services. The height and weight data for the military corresponds more closely to the height and weight data for males of the same age determined in the course of the Health and Nutrition Examination Survey conducted on a statistical sample of the American civilian population by the National Center for Health Statistics than they do with the referenced men cited in the RDA. The MDA was established to satisfy the needs of the most susceptible sub groups in the military population. Present within the military are many sub groups that are required to perform physical activity in their occupational specialty at a moderate level (or greater) of physical activity.

As previously stated, the MDA only significantly varies from the RDA for three nutrients, energy, protein and ascorbic acid. The reasons for the variations for the three nutrients will be discussed.

Factors influencing requirements for energy in the late adolescent and adult male include physical activity, body size, climate, and growth requirements for the late adolescent. All studies available indicate that military personnel is larger than the referenced man used in the RDA and many sub groups of military personnel are expected to be consistently more active than the referenced male of the RDA. In addition, allowance should have been made for the increased needs for final growth of the 17 and 18 year old males within the armed services but, because of the minimal number of 17 year olds in the services, complete recognition of this need was not given. Because of these factors the Daily Dietary Allowance for Energy was established at 3200 kcalories per day, with the realization that if the number of 17 year olds were to increase significantly (as during a period of mobilization) that this allowance would undoubtedly have to be increased.

Protein allowance provided by the MDA is at considerable variance from that provided in the 8th edition of the RDA.[8] It is emphasized that the RDA in Table 5 is from the 8th edition. In some previous editions, the RDA for protein has been as much as 25% higher than that given in the 8th edition. There are a number of factors that influence the choice contained in the MDA. Adolescents, still in the growth phase, have a higher requirement for protein than do 19 to 22 year old males. The RDA is based upon 0.8 grams of protein per kg of body weight per day.

We have already cited that the size of the military population of concern i.e., 17 to 25 exceeded that of the referenced males in the RDA. Had the protein level from the RDA and the 3200 kcal allowance cited in the MDA been used the dietary protein allowance would have provided only 6.75% of the calories from protein. The average American diet provides between 12 and 15% of the calories from protein and the foods providing the protein are generally sought after or favored items. At the meeting of the committee that established the MDA there was marked concern expressed by the personnel involved with food service that if we used the RDA recommendation for protein that the patronage of the food service facilities would decrease even further if that allowance for protein were ever used in formulating menus for the dining facilities. There was further concern that if the intake of protein were limited to that in the RDA that difficulty would be encountered in obtaining sufficient iron intake for the personnel to receive their daily needs. Therefore, the level of protein intake recommended was chosen to equate with the normal American consumption pattern. The allowance of 100 grams of protein per 3200 calories provides that 12.5% of the calories will be derived from protein. This figure corresponds quite closely with the recommended protein intake contained in the "Dietary Goals for the United States" promulgated by the Select Committee on Nutrition and Human Needs of the United States Senate.

The recommendation for ascorbic acid for adults, contained in the RDA was based principally on studies conducted by the USAMRNL and joint studies conducted by USAMRNL and the University of Iowa. The design of these studies permitted determination of the exact daily rate of utilization of ascorbic acid. These studies demonstrated that men under moderately severe emotional stress utilized up to 57 milligrams of ascorbic acid per day. This fact was transmitted to the committee formulating the RDA but they chose to ignore that observation allegedly because persons under moderately severe stress did not represent the normal population. It was the feeling of the committee formulating the MDA that military personnel may be subjected to the extremes of emotional stress through combat exposure to adverse climates social privation or deprivation, extremes of altitude etc. Because of that, the Committee recommended retaining the MDA for ascorbic acid at 60 milligrams per day as had been cited in the 7th edition of the RDA. It may be of note that studies that have been completed and, others currently ongoing in Sweden are substantiating this recommendation.

The DOD Manual 1338.10-M directed that the nutritional standards be established for the age 17 through 25. In establishing the allowance for iron the MDA was taken directly from the RDA for 15 to 18 year old males which provides 18 milligrams per day.

In comparing the MDA with the RDA in Table 5 the MDA for thiamin, riboflavin and niacin appears to be greater. However, the thiamin recommendation contained within the RDA is based upon 0.5 milligrams of thiamin per 1000 calories; that for riboflavin, 0.6 per 1000 calories, while niacin is 6.6 milligrams per 1000 calories. These same factors were used in calculating the recommended allowances in the MDA and the slight increase reflects the slight increase in the allowance for energy.

GLOSSARY OF TERMS AND ABBREVIATIONS

ANOVA	Analysis of variance
BUMEDINST	Bureau of Medicine Instruction
Ca:P	Calcium-Phosphorus ratio
COMRAT	Commuted rations (personnel receive cash in lieu of meal/galley pass)
COM-M	Commuted Ration-Married
COM-S	Commuted Ration-Single
kcal	Kilocalories
LAIR	Letterman Army Institute of Research
NARADCOM	United States Army Natick Research and Development Command
MDA	Military dietary allowance
NAS	Naval Air Station
NRC	National Research Council
P	Probability
RIK	Rations-In-Kind (personnel issued meal/galley pass)
RDA	Recommended dietary allowance
USDA	United States Department of Agriculture

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